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Sir John Chetwode, Bar.t
Oakley Hall, Staffordshire.

Elements of Chemiſtry:

BEING THE

ANNUAL LECTURES

OF

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UNIVERSITY of *LEYDEN*.

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SERIES

OF

CHEMICAL OPERATIONS,

Diſpoſed according to the Rules of ART.

Part I. *Upon Vegetables.*

Proceſs

1. A Diſtill'd Water exhaling in form of Vapour from green Roſemary with a ſummer's heat.
2. An Infuſion and Decoction from the *reſiduum* of the firſt Proceſs.
3. A *Sapa*, *Defrutum*, Extract, Rob and Jelly, from the product of the ſecond Proceſs.
4. The burning the inſipid inodorous Herb that remains after the ſecond Proceſs, and ſtill retains its natural figure, into inſipid Aſhes, of the ſame form.
5. The preparations of the third Proceſs being burnt, yield ſalt Aſhes.
6. A green Plant, or what remains from the firſt Proceſs being burnt, produces ſalt Aſhes.
7. The native ſalt of Plants, procur'd from their Juice, freſh preſs'd: An inſtance in Sorrel.
8. The native ſalt of Plants from their fermented Juice, called Wine-ſtone, or Tartar.
9. Salt from green Roſemary burnt according to *Tachenius*'s method.
10. *Sal Tachenianus* from dried *Carduus*.
11. Salt of green burnt Plants, as the Apothecaries prepare it.
12. The acrid igneous fixed alcaline Salt of Plants, and its Liquor, call'd Oil *per deliquium*.
13. A very acrid cauſtic Salt with Quick-lime.
14. An acrid fix'd vegetable Alcali, yields a bitter, chryſtalline, hard, fix'd Salt, that is not alcaline, but ſub-vitreſcent.
15. The common diſtill'd Water of green Roſemary *per veſicam*.
16. The ſame diſtill'd again with freſh Roſemary, called Cohobation.
17. A diſtill'd fermented Water of Roſemary, according to *Ludovici*'s method.
18. A Water diſtilled from green Roſemary *per Deſcenſum*.
19. Salt Aſhes from the *reſiduums* of Proceſs 15, 16, 17, 18, burnt, as from 5, 6, 9, 10, 11.
20. Vegetable Oil by expreſſion: here from Almonds.
21. Native Oils of Plants being, with their containing Bodies, pounded with Water, yield a Chyle, Milk, and Emulſion. An inſtance in Almonds.
22. Native Oils of Plants by boiling them in Water.
23. Diſtill'd Oils *per veſicam*, call'd eſſential Oils, here from the green tops of Savine.
24. A diſtill'd Oil *per veſicam*, from the dried Leaves of Mint.

25. A diſtill'd Oil from Lavender flowers.
26. A diſtill'd Oil from Fennel Seeds.
27. A diſtill'd Oil from aromatic Cloves.
28. A diſtill'd Oil from Saſſafras Wood.
29. A diſtill'd Oil from Cinnamon Bark.
30. A diſtill'd Oil *per Deſcenſum* from Cloves.
31. A *Rob* from the *Reſiduums* of the Proceſſes from 23 to 29.
32. Diſtill'd Oils, Vinegar, Spirits, a twofold Oil, Coal, and Aſhes from Guaiacum-wood diſtill'd in a Retort, without adding any thing to it.
33. Water, Spirits, an alcaline, oily, volatile Salt, an Oil and Coal from Muſtard-ſeed diſtill'd in a Retort.
34. The ſeparation of Oils from the other Bodies united with them in diſtillation, on which depends their rectification, preſervation, and converſion into a Balſam and Reſin.
35. Vinegar, Spirits, a twofold Oil, Reſin, and Colophony, from Turpentine diſtill'd in a Retort.
36. Water, Vinegar, a fetid Spirit, and a Butter drawn from Wax in a Retort.
37. Butter of Wax, by repeated diſtillation, converted into a liquid Oil.
38. Medicinal *Elæoſacchara.*
39. Medicinal Potions from the Proceſſes 9, 10, 15—18, 23—31.
40. Artificial ſweet Balſams with diſtilled Oils (23--29) Wax, and Pomatum.
41. Any Meal, even that of corrupt Corn, call'd Malt, mixed with Water, in diſtillation yields a vapid Water.
42. Honey diluted with Water, and then diſtill'd, yields a Water that has only the ſmell of Honey.
43. Meal, and Malt, worked together with a proper quantity of Water, ferment.
44. Honey diluted with Water, ferments.
45. Fermented Malt and Meal (43) being diſtill'd, yield Spirits that burn, and Vinegar.
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48. Alcohol from the fermented Spirits (45, 46, 47.) without any addition.
49. The production of Alcohol by Alcali's.
50. The origin of Vinegar.
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57. Tincture of Myrrh by 12, 55, 47, 48, 49.
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59. Tincture of Benjamin by 47, 48, 49.
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61. Tincture of Scammony by 47, 48, 49.
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72. A compound aromatic Spirit.
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83. An *Elixir Proprietatis* with the fixed Alcali, 12.
84. An *Elixir Proprietatis* with tartariſated Tartar.
85. An *Elixir Proprietatis* with regenerated Tartar.
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87. The *Analyſis* of Amber.
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PART II. *Upon Animals.*

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90. The ſame coagulates with Acids, and with the heat of boiling Water.
91. If the ſame is boiled with a fixed Alcali, it coagulates, grows firſt yellow, then red.
92. Freſh Urine is neither acid, nor alcaline, but fetid.
93. Freſh Urine diſtill'd cloſe, yields a nauſeous fetid Water, that is neither acid, alcaline, nor ſaline, nor ſpirituous like what is drawn from Wine.
94. The *reſiduum* of the preceding Proceſs, is not acid, nor alcaline, but ſaline, and fetid, tho' not truly ſaponaceous.
95. The ſame Urine inſpiſſated to $\frac{1}{40}$th, and then diſtill'd with ſand yields an alcaline Spirit, a volatile alcaline Salt, a very fetid Oil, and ſaline *Fæces*.
96. Freſh Urine inſpiſſated and diſtilled with a fixed Alcali.
97. Quick-lime mixed with healthy, freſh Urine, eſpecially after it is inſpiſſated, makes it yield an igneous Spirit that is not alcaline.
98. The native Salt of Urine.
99. Milk digeſted, throws up a Cream, and grows acid.
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108. The beſt volatile alcaline Salt, or the pureſt alcaline Spirit, and Vinegar, make a ſalt Spirit.

109. The White of a new Egg, is neither acid, nor alcalious, nor contains any fermented Spirits.
110. Such a White hardens with the Heat of boiling Water into a ſolid Maſs.
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115. If it is digeſted it putrifies.
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222. The

222. The diſtillation of the Butter of Antimony into a liquid Oil.
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Chemical Solution.
Coagulation.
Precipitation.
Effervefcence.
A ſhort recapitulation concerning Alcali's and Acids.
The production, deſtruction, and alteration of Smells, and Taſtes.
The production, deſtruction, and alteration of Colours.

INTRO-

INTRODUCTION.

IN examining into the writings of the Chemiſts nothing has given more diſguſt to men of ſenſe, than the multitude of Experiments they met with, deſcrib'd without any manner of order, under the title of Proceſſes. For the number of theſe is ſo great, and the nature of them ſo different, that a man's life would ſcarce be ſufficient for going through 'em, were it poſſible for his patience to hold out to the end. But what is ſtill a greater difficulty in our way, in the proſecution of theſe ſtudies, is our really not knowing the deſign with which the Artiſts themſelves have taken all this pains: for if as a Philoſopher you conſult them upon this head, you'll ſcarce meet with any thing to your ſatisfaction. And afterwards, when Chemiſtry came to be taught in the Univerſities, the practical part of the Art ſeems to have been intirely confin'd to the exhibiting ſome Operations in an irregular manner, juſt as every particular Profeſſor thought proper. When I firſt therefore ſet about teaching the chemical Art, which is now more than thirty years ago, I carefully conſider'd with myſelf, whether it was not poſſible to give my Pupils Examples of all the chemical Operations in ſuch a manner, that, according to *Hippocrates*'s Rule, nothing ſhould be left out, that was of Conſequence to be known, nor any thing be added, that was not neceſſary.

In order to this, then, in the firſt place we muſt take Care, that we don't do the ſame things over again; for what can be more trifling than to give repeated inſtances of what may be ſufficiently underſtood by one? Thus for example, when I have once ſhewn you, by what art you may procure a fragrant water from Baum, there will be no need to tire your patience with the ſame thing again in ſweet Marjoram, Roſemary, and Rue: Nor when we have taught you how to draw an aromatic Spirit from Citron-Peel with Spirit of Wine, will it be neceſſary to repeat the ſame with other Bodies of the like nature.

But here however it will be abſolutely neceſſary to give an ocular proof of every particular Operation that has any thing peculiar in it, and which is proper to be known in the Art, and does not evidently appear by ſome other Experiment: for every Perſon that has a mind to get acquainted with the chemical Art, ought to be acquainted at leaſt with the Methods, by the help of which, are prepared thoſe things that are here of ſervice; nor can he ever be a perfect Artiſt without 'em. Thus for inſtance, if we want to know the nature of vegetable Salts, of what conſequence is it that we have ſeen the manner of procuring their Salt from them by burning them, unleſs we know likewiſe from experiment, how from ſome of 'em it may be procur'd too by diſtillation, and putrefaction.

In the third place, I thought, we ſhou'd moſt probably attain our end by following here the method uſed by the Mathematicians; that is to ſay, always to exhibit that Operation firſt, the knowledge of which is neceſſary to the right underſtanding, or proper performing that which follows, and then to link them together in ſuch a manner, that every one may ſtand next to that on which it moſt directly and immediately depends: for by this means we ſhall with the leaſt labour and expence, and in the ſhorteſt time come to the knowledge of the principal uſes of the whole Art, whoſe excellence in particular is this, that it opens to the human mind the powers of Nature, and furniſhes us with proper helps for ſecuring, and reſtoring of health.

In the laſt place, in compoſing this practical part of Chemiſtry, I thought I ought not to regard the ſervice of Phyſic only, tho' I prefer that to all other Arts; for nothing has prov'd more fatal both to the chemical, and medicinal Art, than an idle Opinion, that all kinds of chemical Productions were proper to be made uſe of as Medicines. Certainly, Chemiſtry is not only aſſiſtant to Phyſic, but its uſefulneſs extends likewiſe to every branch of natural Philoſophy. See Vol. I. p. 50. *& ſeq.* Let the Phyſician therefore rejoice in the labours of the Chemiſt, but by no means claim them wholly to himſelf.

Since the Operations, now, of the chemical Art are taken up in the examination of Vegetables, Animals, and Foſſils, hence we ſhall diſtribute them according to theſe three kinds of Bodies. And here we ſhall be obliged to begin firſt with the vegetable Kingdom, as the Productions of this are always and every where at hand, and as moſt Animals even ſubſiſt upon Vegetables, and are really made up of them, after they are, by their proper concoctive powers, aſſimilated to the animal Nature; for if there are ſome of them that intirely live upon other Animals, yet if you will look back to what theſe fed upon, and ſo on, you will at laſt come to ſome, which were ſupported by Vegetables, and thus laid the *Baſis* of all the following. But beſides, Vegetables, on account of the ſimplicity of their conſtituent parts, and their readier ſeparation, are chemically reſolved with more eaſe, and underſtood with leſs difficulty. Foſſils, indeed, it muſt be confeſs'd, are ſtill more ſimple, but then the management of them requires a profounder Skill, Inſtruments much more occult, and Operations not ſo obvious. The nature of the thing, therefore, leads us to begin with the Vegetable Kingdom.

And here we ſhall ſuppoſe you are acquainted with all thoſe things which were explained to you in the *Theory of the Art*, Vol. I. from p. 36 to 40, and which, according to our preſent deſign, will be here all confirm'd by Experiments.

A chemical Operation, now, is the changing a Body by Inſtruments proper to this Art, and in ſuch a manner as this Art determines. And the firſt Operation that is performed in a courſe of chemical Demonſtrations ought to have theſe four Conditions: In the firſt place, it ſhould be very eaſy; not requiring a great deal of labour, nor much force to be exerted upon the ſubſtance to be worked upon: Secondly, it ought to be very ſimple, not being compounded of different Operations, nor wanting a great variety of Inſtruments to its performance: In the third place, the alterations induced upon Bodies by this firſt Operation ought not to change them too much from their proper nature: And fourthly, we ſhou'd take care, that the Effect of this Operation ſhou'd, as much as poſſible, be a mere ſeparation of the parts, juſt ſuch as exiſted in the Body before the reſolution, and not a production of new ones by means of this very Operation; for as by our Art Bodies are ſeparated either into their natural conſtituent parts, or into others, actually produced by their being expoſed to the Fire, it is plain, that in the firſt Operation, the former only ſhou'd be extracted, which being afterwards properly compounded together, we are certain, would again produce exactly the very ſame Body.

If theſe four circumſtances, now, are carefully attended to in this firſt Operation, there will four very conſiderable advantages ariſe from it likewiſe: For in the firſt place, the Operator will hence evidently and certainly learn, of what kind the parts were, that actually exiſted in the Body before the reſolution, and are now ſeparated from it; and by this means will be able to form a judgment of the nature of the compound thus examin'd, and of the parts that concurr'd towards its compoſition; whereas if we have not a proper regard to theſe conditions, we ſhall fall into very great miſtakes, if we imagine that the parts procured from Bodies by a chemical *Analyſis*, did in reality exiſt in the ſame manner in the Bodies themſelves before the ſeparation. But in the ſecond place, the Chemiſt will hence have an opportunity of examining with certainty the *reſiduum* that is left after the firſt Operation is compleated; for if by this, nothing but the native parts are gently ſeparated, the remainder will ſuffer very little alteration. In the third place, the remaining part will be hence properly ſuited for farther examination, and ſo may be gradually expoſed to the efficacy of various other chemical Operations; whereas, if the object was very conſiderably altered from its proper nature, any future trials upon it wou'd be of very little ſervice, nay, wou'd rather puzzle the affair than illuſtrate it. And in the laſt place, we ſhall hence have a very accurate knowledge both of the action made uſe of in the Operation, and of the inſtruments by which this action was excited, without any danger at all of confuſion: Of what conſequence now theſe advantages are in the Chemical Art, the thing ſpeaks itſelf. For my own part, I ſhould have been heartily glad to have met with any Author, who had proſecuted his Experiments upon theſe Principles.

But in the Body itſelf that is expoſed to this firſt Operation, there are ſome particular circumſtances requiſite likewiſe. And of theſe this is the firſt, that the matter that is ſeparated from it by this Operation ſhould be the moſt ſimple that cou'd be produc'd by any; ſo that from all Bodies it might be nearly of the ſame nature, ſuch as we look upon Water to be. Secondly, this Body ſhould be of ſuch a nature as properly to yield theſe parts, thus extracted from it, without being itſelf firſt compounded from them. And thirdly, it ſhould be one that is eaſily ſeparable into thoſe parts which we propoſe to procure from it: For it is poſſible, that a Body that is ſimple, and may be manag'd with eaſe, may not be reſolvable into the parts of which it is made up, without a vaſt deal of Difficulty; as is ſufficiently evident in Gold, Silver, and Mercury. And the advantage of attending to theſe circumſtances in examining this firſt Body, will be particularly this, that by this means, the ſeparation will be brought about in the moſt natural order, and the remainder will be properly diſpoſed to give out diſtinctly any other parts that may be afterwards procur'd from it by a farther chemical Examination.

But again, the Inſtrument made uſe of in this firſt Operation muſt have its particular properties likewiſe. For this in the firſt place, ought to be exceeding ſimple, that ſo the operating cauſe, excited by means of this inſtrument, may be eaſily underſtood and applied, and at the ſame time, by reaſon of its ſimplicity, it may not taint the Body to be chang'd, by an admixture of its parts, which are often of a different nature. Secondly, the action of the inſtrument thus made uſe of, ſhould be of ſuch a nature, as to enter into the following Operations likewiſe; ſo that hence this inſtrument may be a kind of univerſal

verſal one, concurring in all other Operations, and lending its aſſiſtance to other inſtruments. In the third place, it is neceſſary, that this inſtrument ſhould change the form of the Body as little as poſſible, no more than is juſt abſolutely neceſſary for performing this firſt Operation; for without this caution, we ſhall do nothing diſtinctly: And laſtly, this inſtrument muſt not by its action much alter, and confound with one another the different parts that may enter into the compoſition of the Body under examination: For if theſe parts ſhould either be conſiderably altered, or confuſedly mix'd and compounded together into a different ſubſtance, the Operation of ſuch an inſtrument wou'd do more harm than good in our Philoſophical Inquiries.

When an inſtrument then qualified in the manner deſcribed, applies its proper action to a Body circumſtantiated as above, then the Operator will know accurately the power of this firſt action; and in any following Operation, ſo far as the efficacy of this is concern'd in it, he will be able to determine what will happen there likewiſe: All theſe effects, therefore, will be evident, and diſtinct, ought firſt to be known, and will give light into others. And hence, in particular, which will be of excellent ſervice, we ſhall be able to diſcover very clearly, what parts do in reality naturally concur towards the compoſition of the Body under examination.

From all theſe things laid together, then, at length it follows, that the action of a ſoft Fire, ſuch a one as is ſpontaneouſly every where preſent, applied to the liquid and moſt volatile parts of Vegetables, as it makes very little alteration in them, and ſeparates them very gently, will perform this firſt Operation.

But every Vegetable, now, is compounded of parts both ſolid and fluid.

The ſolid parts of Vegetables, are either Veſſels, or larger firm parts, formed by the coaleſcence and concretion of theſe together.

The abſorbent veſſels of Plants, by their open orifices, ſuck in the more liquid fluids that are applied to them. Theſe apertures are diſperſed through the whole ſurface of every part of the Plant, but more particularly in the root inſerted into the Earth. In a moiſt warm Air, and in a damp warm Earth, they are dilated; and on the contrary, are contracted by cold, and drought. Hence, thoſe that are covered in the Ground, are larger than thoſe that are expoſed to the Air: And hence too they take in more juices in Summer, than they do either in Autumn or Winter. But there are ſome Orifices likewiſe that draw in the Air, in the manner of a Windpipe, and convey it into the more intimate parts of the Plant, as appears very evident in the ſtalk of the Dandelion.

Again, in Plants there are Veſſels fitted to carry on a circulation, containing the Juices imbibed by the abſorbent Orifices, and propelling them from theſe Apertures through every part of the Plant. And this propulſion ſeems principally owing to Heat and Cold, the firſt dilating, the other contracting, and thus, by their contrary actions alternately ſucceeding one another, diſpoſing the elaſtic Fibres to a continual agitation of the included Fluids. Are there any Valves here likewiſe? This has not yet appear'd to the Senſes. And indeed, the ſucceſsful growth of ſome Plants, when the ſtem has been inverted, ſeems to evince the contrary; for had there been Valves, they muſt have prevented it.

A third kind of Veſſels in Plants are thoſe, which change the Juices they receive, in ſuch a manner, that they become of a quite different nature from what they were before: For theſe, when they are admitted into the beginnings of the Pipes, are by no means the ſame, as when they have circulated through the Plant, but gradually put on the nature of every particular one, in proportion as they have been longer expoſed to the action of a greater number of its Veſſels, as appears by every kind of Experiment. And there ſeems to be a *ſeries* of Veſſels ariſing in a proper manner from one another, in every one of which, there is continually prepared a new ſort of Juice in various parts of the Plant.

But farther, in the fourth place, amongſt thoſe Veſſels there are obſerv'd ſome too, which ariſing laterally from thoſe larger ones, receive into them a particular Juice, which theſe again perfect more and more, according to its peculiar nature; as we ſee evidently in the Aloetic Ducts of the Aloe, which contain a Liquor perfectly diſtinct from every other contained and generated in the reſt of the Veſſels of the ſame Plant. In the Celandine too, there are Veſſels which in the ſame manner ſeparate, and prepare a golden Juice; as we ſee a milky one in its proper Veſſels in the Spurge.

But in the fifth place, we muſt here take notice likewiſe of thoſe particular repoſitories in Plants, which receive the Juices prepared by the laſt-mentioned Veſſels, and detain them for a conſiderable time, by which means they ſeem to undergo ſome farther alteration, and be carried to greater perfection. Thus we ſee a pinguious matter collected, detained, and perfected, in particular cells, and paſſing often through a great many very diſtinct forms; as is ſufficiently evident in Native Oils, Balſams, and Reſins.

And ſixthly and laſtly, there are excerning Veſſels too, which naturally exhale the finer Juices out of the Body of the Plant, or by burſting from the too great quantity of the contained fluid, diſcharge themſelves on the external ſurface. This needs no proof at all, for every one knows, that Fluids are ſeparated from Plants in an inviſible form; and that Gums and Reſins break their Veſſels, and run out of them.

In every particular kind, now, of theſe Veſſels, the Juices are found to be perfectly different, diſtinguiſhing themſelves by their proper nature from all the reſt: And this difference does not only conſiſt in their Fineneſs, Thickneſs, Fluidity, Tenacity, Acrimony, and Softneſs, but in their Colour, Smell, Taſte, Medicinal, Nutritive, and Poiſonous Qualities likewiſe. And in different parts too of the ſame Plant, there is the ſame variety obſerv'd, even to the very minuteſt: Thus in the little repoſitories in the *Petala* of the flower of the Aloe, we find a honeyiſh Liquor, whilſt the Juices in the other parts are bitter. And in the ſame manner in the Root, Flower, Fruit, Seed, Leaves, Bark, and Wood of Vegetables, there are found various ſorts of Juices. But even theſe native Juices of Plants are themſelves compounded of perfectly different kinds of Elements, mixed together in a certain proportion; and hence, as this varies, their appearances again are very different. From this various mixture, therefore, ariſe Aqueous, Spirituous, Saline, Saponaceous, Gummy, Oily, Balſamic, Reſinous, and Gummy-Reſinous Fluids, and thoſe that ooze out in form of tears, or diſtill, upon an inciſion made in the Bark, or upon wounding the tender Twigs, in form of a limpid, acidiſh Liquid; as we ſee evidently in the Vine, Birch, Walnut-tree, and many others. Theſe things, Gentlemen, it was neceſſary to premiſe to you, before we ſet about our firſt Operation, that you may ſee how we may come at ſomething diſtinct and certain in this affair, if we proceed cautiouſly in the method propoſed, and how much confuſion muſt follow an Operation that is not ſo properly regulated. From what has been ſaid now, give me leave to draw the following Corollaries.

In the firſt place, then, there is a vaſt deal of difference in the Juices of Plants, with regard to the Chemical Art, as in theſe there are ſome parts ſo volatile, that they either ſpontaneouſly exhale, or ſuffer themſelves to be ſeparated with a very little trouble, ſo that if they are expoſed but to a very ſoft Fire, they will be diſengaged from all the reſt, almoſt in their natural ſtate, and original purity; whilſt on the contrary, others are with difficulty extracted from their concrete, require a greater degree of Fire, and conſequently, when they are ſeparated, will be more blended and confounded with one another.

In the ſecond place, as there is ſuch a variety of Juices contain'd in different parts of the ſame Plant, hence there will be a vaſt deal of difference in our Chemical Operations, according as one, or other of theſe come under Examination. Does not the pulp extracted from the pods of the Caſſia yield ſomething vaſtly different from what the bark does? As the medullary part of the Sugar-cane affords ſomething exceeding ſweet, whilſt what is drawn from the other parts, is inclining to the acid. We ſhould not haſtily ſay, therefore, that we have by the Chemical Art procured ſuch and ſuch ſubſtances from any Plant, without firſt carefully taking notice what particular parts we made uſe of in the Operation: If we do, we ſhall labour in vain.

But in the third place, as in the particular parts of moſt Vegetables, there is obſerved ſuch a great difference of Colours, as we ſee in Apples, Pears, Cherries, Strawberries, Mulberries, and other Fruits, as well as in the Leaves, and the beautiful variety of the Flowers; hence this too, according to the various manners of extracting the Juice, will be found to be different. Thus, the Spurge, for inſtance, and the Poppy, if they are ſlightly wounded, diſcharge an exceeding white Milk; whereas, if the whole Plants are pounded together, the Liquor that comes from them is of a browniſh green. The Root of the Bete, on the other hand, when it is pounded, gives a Liquor that is very red, tho' the colour of it is not ſo, if you make a ſlight inciſion in it. This diverſity, therefore, ought to be attended to.

In the fourth place, we take notice of the Scents of Plants; and here how great is the variety? In the Jeſſamy, all the other parts are inodorous, the Flower only ſo ſweetly ſcented. In the Citron, the Peel of the Fruit, the Juice, the Leaf, Flower, and Wood, have all a different ſmell. And here there ſeems to ariſe a particular ſcent in the various Juices of the ſame Plant, as they are more remote from the pores of its bibulous ſurface. This conſideration now of the ſmells of Plants, ought to be ſo much more taken notice of, as they ſerve to diſtinguiſh them ſo accurately from one another, and are ſeparated from them, by the firſt in particular, of our Chemical Operations.

In the fifth place, we obſerve farther, the vaſt variety there is in the Taſtes likewiſe of different Plants; which is ſo remarkably great, that among ſo many thouſand of different kinds, you will ſcarce ever find two in which it is perfectly the ſame, every one having a Taſte peculiar to itſelf. Nor is this only the caſe in different Plants; but even in different parts of the ſame Plant, we find, upon examination, that it holds good likewiſe. And this, in the ſame ſenſe, is true too of their Smell and Colour.

But in the ſeventh place, the Juices of the very ſame Plant appear ſo different from themſelves at different times, that one wou'd ſcarce take 'em to be the ſame, whether you regard the Colour, Smell, or Taſte, not to mention their particular vertues, which differ ſo much in crude Vegetables, and thoſe come to maturity, that there can be no compariſon between them. For if we examine the very ſame Vegetables in the Spring, Summer, Autumn, and Winter, we evidently find ſo great a diverſity in them, that they don't ſeem at all to be the ſame. Thus ſome Plants, when they are in flower, are exceeding fragrant, which at other times are quite inodorous. Hither too may be referr'd that difference that ariſes from the various Soils in which the Vegetables are planted; for we ſee thoſe that grow in mountainous places are of another nature from thoſe that grow in grounds that are marſhy.

In the eighth place we obſerve, that almoſt all Plants at the time they ſpring, increaſe and flouriſh, abound with watery, thin, ſaline Juices, and at that time contain a good deal of Salt; whereas when they have undergone the heat of the ſummer, their Water is exhaled, and they are replete with Spirits, and Salt, but more particularly with a pinguious Oil. What is drawn from the very ſame Plants, therefore, and by the ſame Operation, will be found at various times to be perfectly different.

But I add, eighthly and laſtly, the chemical Art, therefore, let it be cultivated with ever ſo much caution, can ſcarcely preſerve the peculiar Properties of Herbs without any alteration; for it always mixes together all the parts that are firſt and eaſieſt ſeparated from them, changes them in ſome meaſure from their original, and eaſily mutable nature, and gives them not only new forms, but new qualities. Far be it from us therefore to imagine, that the Chemiſts can always by their Operations ſeparate for us thoſe excellent vertues with which Nature has endued many particular Plants, ſince they very often, nay indeed for the moſt part, mightily alter them, and often change them into ſomething that is quite contrary. This the Chief of the Chemical Tribe *Van Helmont* openly acknowledges, p. 141, § 45. p. 458, 459, where he expreſly ſays, *Happy is the Man who knows how to remove diſtempers quickly and ſafely by crude Simples, which is the moſt ancient method of cure, and is commended in the ſacred Writings. For the Ens ſpecificum is altered by Fire; and hence Extracts and Magiſteries frequently loſe the efficacious qualities of the Bodies they are prepar'd from: Thus therefore the Chemical Art often ſecretly robs them of their excellence.* And this certainly is a golden obſervation, that deſerves to be attended to in the moſt careful manner. In the mean time however it is abſolutely certain, that the Chemiſt by his exquiſite labour ſometimes produces new Bodies which were not in being before, and indeed with ſuch vertues as Nature was not in the poſſeſſion of; by which means Art is then able to perform what, in the nature of things, was not poſſible before, as with a great deal of reaſon the ſame ingenious Author takes notice in the ſame place.

These things then, Gentlemen, the nature of our ſubject oblig'd me to explain to you, before I could pretend to ſet about our Operations upon Vegetables. If the length of theſe obſervations has been tedious, you'll be pleas'd at leaſt with my care and caution. For one phyſical action being properly performed without any miſtake, will give light into a thouſand others that follow from it; whereas one wrong ſtep here will give riſe to innumerable errors, and the more harm we ſhall always do, the farther we proceed. In proſecuting this affair, now, in the firſt place I ſhall expoſe to your Examination the Bodies I am going to operate upon, before I do any thing with them, that thus you may ſee perfectly what they naturally are before Art has made any alteration in them. And to this purpoſe I ſhall leave them here in Plates, with proper Inſcriptions. In the ſecond place, I ſhall accurately deſcribe, even to the minuteſt circumſtance, the Operation itſelf, with which I ſhall treat the Body thus examin'd, and then ſhall go through it before you, that thus you may be acquainted with the cauſes, which perform the work propoſed. In the third place I ſhall lay before you the effects produced in the Body by the Operation thus deſcribed. And then fourthly I ſhall expoſe to your view the *reſiduum* that is left after the Operation is finiſh'd, that by accurately examining this, and carefully comparing it with the Body before the Operation, you may be able to diſcover all the ſenſible Alterations that have happen'd in it. In the fifth place I ſhall punctually deſcribe the Inſtruments I have occaſion to make uſe of in every particular Operation. In the ſixth I ſhall draw ſome Phyſical Corallaries, evidently flowing from the Operation we have been engaged in. And then, ſeventhly and laſtly, ſhall add the medicinal vertues of Bodies thus chemically prepar'd. And here I ſhall be particularly careful to advance nothing but what is confirm'd by Experiments, and ſhall cautiouſly avoid extolling them to an extravagant degree, and aſcribing more vertue to any thing than what it really poſſeſſes. Hence I ſhall take notice of the inſignificancy of ſome, and the pernicious nature of others that too often meet with a commendation which they do not deſerve. And in this point particularly it's ſcarce poſſible, but I ſhould be of ſome ſervice to you, as the careful obſervation of betwixt 30 and 40 years, that I have been cloſely engaged in Chemiſtry and Phyſic, muſt have render'd me tolerably acquainted with theſe things; nor have I the leaſt Temptation to deceive you.

In the firſt place now I ſhall begin with a freſh, crude Vegetable, that is not yet chang'd from its natural diſpoſition; and from this I ſhall firſt draw that part that wou'd have exhal'd with the Summer's heat, which is moſt volatile, and ſufficiently ſimple. And here I will make as many Experiments as I can ſucceſſively upon the very ſame Plant, that by this means you may accurately learn, what different Operations, digeſted according to Art, and applied in a regular manner, are able to effect upon it. Thus, after I have exhibitted to your view all the chemical methods by which a fragrant Water may be drawn from green Roſemary, I'll proceed to ſhow all thoſe by which the Salts, Oils, and other principles may be procur'd from the very ſame Plant, as far as is any ways poſſible, as this is the way to get an accurate and diſtinct knowledge of the Actions of the Chemical Art: Whereas, if, on the contrary, the Water is prepared from one Herb, the Salt from another, the Oil from a third, a fermented Spirit from a fourth, and a volatile Salt by putrefaction from a fifth, we ſhall then neither have a clear notion of the *Analyſis* of any Plant by theſe Operations, nor ſee diſtinctly the true action of theſe Operations upon Plants, but ſhall only get a confus'd Idea of all together.

Theſe things then being ſet in a proper light, we now proceed to the Operations themſelves, with ſome Hopes of Succeſs.

CHEMICAL OPERATIONS,

PART I.

Upon VEGETABLES.

PROCESS I.

A diſtill'd Water, exhaling in form of Vapour from green Roſemary, with a Summer's Heat.

APPARATUS.

1. TAKE a Plant gather'd in its prime, and in the morning, whilſt the dew is yet upon it, that is not bruiſed, and by this means has its Juices blended together, but that ſtill contains them all in their diſtinct Veſſels, juſt as nature had diſpoſed them, and that has not the leaſt foreign matter mix'd with it, except the dew that adheres to it.

2. Upon a circular, broad, clean plate fitted within the cylindrical Furnace. Pl. XVII. Fig. II. let this be laid freſh gather'd to the height of two or three inches, gently, without preſſing it down: Then let the Furnace be cover'd with a large conical pewter Head, and to the noſe let there be applied a glaſs Receiver.

3. With a clear live Coal, not at all ſmoaky, diſpos'd in the fire-place, let there be excited an equable heat, not exceeding 85 Degrees in *Fahrenheit*'s Thermometer, which muſt be kept up as long as any liquor diſtills into the Receiver. You may then take out the herb and put in ſome more freſh, and treat this in like manner, and ſo proceed till you have procured a ſufficient quantity of this Water.

4. Let the Liquor thus prepared be ſet by for ſome days in a cold place, and in a clean glaſs Bottle cloſely ſtopt, and then it will be clear, and will have the Smell and Taſte of the Plant.

The NATURE and USE of this WATER.

IN this Liquor then is contained, 1. the Dew, which is made up of its proper parts, Vol. I. p. 273, which are not clear'd from the Plant, without a great deal of difficulty, and which adhere to it when it is dried. In this Dew likewiſe, thus diſpoſed on the Surface of Plants, are contained thoſe liquid parts of them, which being concocted by the Heat of the day, and exhaling in the night, are entangled in it, and together with it form one Liquor, which is often conſiderably tenacious: This we ſee particularly in Wax, Manna, and Honey.

2. In this Liquor is contained a fine Fluid, that exhales from the Veſſels of the Plant under examination. And this conſiſts chiefly of pure ſimple Water, as appears evidently by letting it ſtand for ſome time in an open Veſſel, for then the Smell and Taſte are loſt, and an inſipid Water is left behind. The other part is that ſubtil, volatile Matter, which gives every Plant its peculiar Smell and Taſte; for this the ſenſes plainly perceive in this Water, but after the Operation is over, there is ſcarce any thing of it remaining in the *Reſiduum* of the Roſemary.

3. In this, farther, ſeem to be contained Seeds or other little Corpuſcles, from which in time there generally appears in it a very fine kind of Weed, or Mucilage, of a whitiſh colour, which is ſuſpended in the middle of the Liquor, and grows gradually broader and broader. Theſe Waters I have kept in Veſſels very cloſely ſtopt, and let them ſtand very quiet, and after a year I have obſerved this began to be formed, and then every year grew gradually larger and larger, till at laſt the whole Water was grown turbid, opake, and ſlimy with this Mucilage. This Liquor therefore contains elementary Water, and the *Spiritus Rector* of the Plant, which, though it is in an exceeding ſmall quantity, yet is wonderfully efficacious, and gives to every Plant its diſtinguiſhing Smell and Taſte. Hence this Water, when it exhales, is the Vehicle of this Spirit, which poſſeſſes in a very ſmall compaſs the ſingular vertue of the Plant, is vaſtly ſubtile and volatile, and hence eaſily ſeparable, and when it flies off, leaves the remainder vapid and effete. For this reaſon therefore the medicinal vertue of theſe Waters depends chiefly upon the *Spiritus Rector*. And this, in a great number of them, being of a very mobile active nature, affects the Nerves, puts the Spirits in motion, and quickens them when they are languid. But beſides this common principle of action, there is ſomething elſe in it, which is proper and peculiar to particular Plants, and is often wonderfully efficacious. This, according to his odd way of writing, *Paracelſus* called the *Ens Appropriatum*. Thus the fragrant exhalation of Lavender, and Baum, both agree in this, that they ſtimulate and quicken the Nerves when they are torpid, but the ſmell of Lavender has beſides a peculiar efficacy, different from that of the other. And indeed from this ſingular vertue there are often very ſurprizing effects produced in the human Body, which can only be come at the knowledge of, by an hiſtorical account of them, when they have been firſt diſcovered by Experiments. And this proper vertue frequently acts directly contrary to the former common one: Thus the Spirit of the *Indian* tuberous Hyacinth is vaſtly ſweet, but produces wonderful convulſions in hypocondriacal men, and hyſterical Women: Rue diffuſes a very odorous Scent likewiſe, but this removes the diſorders occaſion'd by the former. But we muſt take notice likewiſe that careful obſervation has diſcovered, that to this fine Vapour of Plants are often owing thoſe ſurprizing effects, which vegetable ſubſtances bring about in the human Body, either by evacuation, or ſome other leſs ſenſible manner; for when this alone is ſeparated either from Medicines or Poiſons, they frequently become inefficacious without any loſs of their weight. Let the Chemiſt therefore proceed ſlowly and cautiouſly in extolling the vertues of theſe Waters, nor pretend to do it, till his Doctrine is ſufficiently confirm'd by Experiments. It appears, however, from obſervation, that theſe are frequently of ſervice, when the Spirits are low and faint, and on account of their fragrance, are very grateful to ſmell to; for nothing ſtrikes and revives the brain

and ſenſes more directly than ſuch a Water of Baum when it is pregnant with its Spirit, or that ſingularly ſcented Water drawn from Rue. If theſe Waters, now, are very carefully ſecured in cloſe Veſſels, and are kept in a cool place, they will retain their vertues for a conſiderable time, even for the ſpace of a year; but if this very volatile Spirit can find but the leaſt aperture imaginable, it ſecretly diſengages itſelf, and leaves the Water effete. But from this Operation we learn farther, what part that is, which ſpontaneouſly exhales from Plants, and ſo is loſt, when they are dried by the Heat of the Summer, *viz.* this Water and the Spirit we have been deſcribing. Hence we diſcover, likewiſe, what Liquid that is which firſt riſes in diſtillation; what it is that gives to Plants their proper and diſtinguiſhing ſcent, *viz.* this *Spiritus Rector* alone; and what thoſe *Effluvia* are, which exhale from growing Vegetables, particularly in the Summer time, and in the open Air; for it is very probable, that theſe exhalations which happen continually, eſpecially in the day time, agree in their proper nature with the Liquor that is artificially drawn from the ſame Plants by means of this firſt Operation: Tho' it muſt be confeſs'd, indeed, that in this they differ, that the natural exhalation is carried on by means of new particles perpetually ſupplied by the ſoil that nouriſhes and ſupports the Plant; whereas in our artificial one, only thoſe parts are ſeparated and collected, which were actually in the Plant when it was pull'd out of the ground, nor can afterwards be ſupplied by any freſh recruits. And hence the ingenious Dr. *Hales*, obſerves, in his *Vegetable Statics*, that to this head belongs that Juice, which upon an inciſion made in the branches of Plants in the Summer ſeaſon, diſtills into Veſſels diſpoſed in a proper manner to receive it. p. 50. From theſe Obſervations, then, we underſtand, that Plants may diffuſe ſurprizing vertues through the neighbouring Air, nay, and by the aſſiſtance of Winds to very conſiderable diſtances. Nor ſhould we too haſtily reject the accounts of the ſtupendous effects of theſe *Effluvia* which we meet with in the Natural Hiſtory of Vegetables, as intirely fabulous; as that the ſhade of the Wallnut-tree cauſes heavineſs, and makes the Body coſtive; that the exhalations from Poppies at a ſmall diſtance, occaſion drowſineſs; that the vapour from the Yew has prov'd fatal to a perſon ſleeping under it; and that the ſmell of Bean-bloſſoms being receiv'd into the Noſe for a conſiderable time, has affected the Brain. Certainly, the powerful action of the Sun is capable of exciting Atmoſpheres of Spirits about Plants that are wonderfully efficacious; and the Wind is able to diffuſe them through large ſpaces. The ſhades of thick Woods, by means of the Vapours collected there, have often been the occaſion of diſeaſes, nay, and even death itſelf, to the perſons that lived in them; as has appeared by fatal inſtances in *America*, a country famous for its numbers of poiſonous Trees. Nor is it at all ſurprizing, that this Spirit of Vegetables ſhould produce ſuch various effects; for in every particular one, it is perfectly ſingular, and abſolutely inimitable by any Art, but generally grateful, and beneficial to our Spirits. As in ſome Plants now, theſe Spirits diſcover themſelves evidently to our Senſes, whilſt in others our Organs of Smell and Taſte are ſcarcely affected by them; hence the Chemiſts, for this firſt Operation, have ſet apart thoſe Vegetables, that by their Smell, in particular, are remarkably agreeable. Of the officinal *European* ones, I have here given you a ſhort liſt, with ſome few from the *Indies*.

Southernwood.
Agrimony.
Garlick.
Dill.
Angelica.
Aniſe.
Maſterwort.
Oranges.
Calamint.
Sweet Cane.
Cardamoms.
Caraway.
Cat-Mint.
Garden-Cloves.
Caſſia-Wood.
Selery.
Onions.
Chervil.
Camomile.
Cinnamon.
Citrons.
Scurvy-graſs.
Coriander.
Saffron.
Cummin.
Dittany.
Fennel.
Galangals.
Clary.
Hyſſop.
Jeſſamyne.
Bay.
Lovage.
White Lilies.
Lilies of the Valley.
Limons.
Mace.
Marjoram.
Marum.
Feverfew.
Melilot.
Baum.
Mint.
Spignel.
Creſſes.
Wallnuts.
Nutmegs.
Baſil.
Origany.
Poly-mountain.
Leeks.
Roſes.
Sage.
Savory.
Wild Thyme.
Saxifrage.
Hartwort.
Tanſy.
The Tuberoſe.
Valerian.
Violets.

TREES.

The Fir.
Orange Tree.
Benjamin Tree.
Box.
Cedar.
Citron Tree.
Pockwood Tree.
Wallnut Tree.
Juniper.
Bay Tree.
Maſtich Tree.
The Limon Tree.
Myrtle.
Peach Tree.
Pine.
Roſe
Savine.
Elder.
Saſſafras Tree.
Storax Tree.
Tree of Life.
Lime.

Of theſe Vegetables now, ſome contain the volatile aromatic part that comes out in this Operation in one part, ſome in another. Thus their peculiar vertue is found ſometimes in their Root, witneſs the camphorated balſam in the Root of the Cinnamon; in their Wood as in Roſewood; in their Bark as in Cinnamon; in their Catkins as in the Wallnut; in their Flowers, Leaves and Seeds very frequently; in the Water that diſtills from them, as in the Wallnut-tree; and in their Balſams, Gums, Tears, and Reſins, as in the balſamic ones. All theſe things, then, Gentlemen, we learn from this firſt ſimple Proceſs, to which more might ſtill be added, but I am afraid I am grown tedious already.

PROCESS II.

An Infuſion, and Decoction, from the remainder of the firſt Proceſs.

THIS ſecond Operation ought to be ſet about and performed, exactly with the ſame cautions as we gave concerning the former, and then it will have the ſame advantages. Since, therefore, it appeared in the preceding Proceſs, what was the effect of a dry Heat of 85 degrees; hence we ſee, in what manner Fire and Air act upon Plants in this degree. We ſhall now, then, examine what effects Fire and Water have upon them from the 85th degree, to the 212th, or that in which Water boils; for Water heated 85 degrees only, will diſſipate the Water of the firſt Proceſs; and hence this is known already.

APPARATUS.

I. TAKE the Roſemary that remains after the firſt Operation. This has loſt its greenneſs, and is turned brown; its Body which was before full, and ſucculent, is contracted, become ſhrivel'd, and lighter; it has very little left of its natural Smell; it has acquir'd a Taſte ſomewhat different from that, proper to Roſemary; and it now may be eaſily rubb'd to pieces betwixt one's Fingers, tho' before it was tenacious, and viſcid. This you have all been eye witneſſes to, as I left each ſort in a plate for your examination. Or inſtead of this, you may take the ſame Herb moderately dried in an open ſhady place, or indeed, juſt gathered, for this will make no conſiderable difference, as the Water of the firſt Proceſs will be always ſeparated and loſt in the boiling.

2. Upon this, in a clean Veſſel, pour pure Rain-water heated from the 85th degree, to the very next to that of ebullition, *viz.* the 211th; and take care that the Herb is perfectly covered with the Water. Let them ſtand in this degree of Heat for the ſpace of half an hour, or more, in a cloſe Veſſel, and then let the Liquor be poured off. This is of a brown colour, without much ſmell, but has the taſte of Roſemary, deprived of the Water of the firſt Proceſs. This is called an infuſion of Roſemary, and contains its vertues not a great deal altered. If the Water of the firſt Proceſs is added to this, the Mixture will poſſeſs the proper medicinal vertue of the Plant; and perhaps this is the beſt method of preſcribing them, except you prefer their expreſs'd Juices.

3. Or you may boil the Herb in Water for the ſpace of a few minutes; and then the Liquor poured off, is call'd a Decoction, or Apozem. If this is per-

formed in an open Veſſel, you loſe all the Water of the firſt Proceſs, and a good deal beſides, as will appear in Proceſs 15, 23—30. But if this is perform'd in a tall chemical Veſſel, with an Alembic over it, and a proper Receiver, then, if to this Decoction you add the Water that exhales, it will contain what is principally medicinal in the Plant. And if it is done in *Papin*'s Digeſter, it will poſſeſs the whole vertues, without the loſs of the Spirits or Water of the firſt Proceſs. The proper quality, however, of the Plant, as it diſtinguiſhes itſelf by its Smell and Taſte, will here be found to be ſomewhat altered, and it will differ a little too in its effects. Preſerving the Smell, Taſte, and Colour intirely, is certainly in this caſe exceeding difficult.

4. Upon what remains after the firſt Decoction, I put more boiling Water, keep it conſtantly boiling, and then pour off the Liquor, carefully taking off all the ſcum that riſes during the boiling, which I put into a clean Veſſel, and keep by itſelf: This is oily, and being gently dried will burn. And thus I proceed to put on freſh Water, and collect all the ſcum, and pour off the Decoction, till the laſt Water, after it has boiled for a conſiderable time, is as pure, and has no more Colour, Taſte or Smell, than when it was put on; and during all this time, I take all poſſible care that no heterogeneous matter, as Soot, Smoke, or the like, ſhould come amongſt it. This, however, is a tedious Operation, nor will be compleated in leſs than twenty times boiling; and yet, which is pretty ſurprizing, the Leaves of the Roſemary will ſtill remain intire, will be full of Water, and will be of their former ſhape and ſize, but their green Colour will be changed to a brown one, and they will ſink to the bottom of the Water, tho' they ſwam in it before.

5. The denſer a Plant is, and the more tenacious on account of its greater quantity of Reſin, the more of this oily Scum will riſe to the top, and the leſs of its oily reſinous vertue will be communicated to the Water, as this is not capable of diſſolving it. And for this reaſon, when a Decoction is to be made with ſubſtances of this kind, they require a previous maceration for a conſiderable time, or the addition of a fix'd alcaline Salt, and longer boiling; as is ſufficiently known in the Decoction of Pock-wood.

6. If ſuch Vegetables, however, that abound with Reſin, are boil'd whilſt they are freſh, green, and full of juice, then their native ſaponaceous part keeping their reſinous part ſtill liquid, makes it diſſolve in Water much more eaſily, than when the Vegetable is dried, and this is form'd into one maſs. This appears evident in the Decoction of the ſhavings of green Guaiacum in *America*, from which they ſoon obtain a very penetrating Liquor with which they cure the Pox; whereas, when the Wood is old, it reſiſts the Water more powerfully, and proves leſs efficacious.

Since, therefore, by boiling them, all thoſe parts are ſeparated from Plants that will riſe in form of Vapour, with 212 degrees of Heat; hence thoſe Plants are unfit for this Operation, whoſe vertues are ſo volatile as to be carried off by this action of the Fire; and on the contrary, thoſe whoſe efficacy is contained in parts that are more fix'd, and that will bear this degree of Heat without exhaling, are properly diſpoſed for ſuch Decoction. Acid, Aſtringent, Viſcous, Aromatic, Demulcent, Emollient, Cooling, Nouriſhing, Saponaceous, and Viſcid Subſtances, not too reſinous, are referred hither, as

Wormwood.
The Thorn-tree.
Wood Sorrel.
Sorrel.
Brooklime.
The Berberry-tree.
Shepherd's Purſe.
Succory.
Quinces.
Dwarf-Elder.
Endive.
Fern.
Fumitory.
Gentian.
Crane's Bill.
Graſs.
Hellebore.
St. John's-wort.
Myrtle.
Water Lilies.
Poppies.
Plantain.
Knot-Graſs.
Purſlain.
Sloes.
Cinque-foil.
Rhubarb.
Currants.
Roſes.
Water Germander.
Comfrey.
Tamarinds.
Dandelion.
Tormentils.
Paul's Betony.
Periwinkle.
Nettles.

As alſo the Juice of any Summer Fruit juſt preſs'd and not fermented.

In the mean time however, I wou'd not have you imagine, that I believe, myſelf, or deſign to inſinuate, that the peculiar vertue of Plants, which almoſt always reſides in their *Spiritus Rector*, muſt neceſſarily diſtinguiſh itſelf, by ſome remarkably diſagreeable, or pleaſant ſmell, or by a warm, pungent taſte; for it is very poſſible, that a Spirit may be vaſtly active, and yet ſcarcely affect our organs of ſenſation, as we ſee evidently in the root of the black Hellebore, the *Cicuta Aquatica* of *Geſner*, the deadly Nightſhade, and many others. Theſe things therefore ought to be very carefully conſidered, before we venture to lay down any general Rule.

The Nature, Vertues, & Uſe of theſe Infuſions and Decoctions.

1. THESE Preparations are capable of paſſing through the Lacteals in the ſmall Guts, and through the meſenteric Veins, and hence of being mixed with the Blood of the *Vena Cava*, and *Vena Porta*, and ſo being blended by the vital actions with the Fluids of the human Body, and being tranſmitted through all the kinds of the larger Veſſels, to the *Viſcera*, and all the other parts; for they are ſaponaceous, penetrating, and miſcible with any of its humours.

2. There, therefore, they can act with that proper and ſingular efficacy that remains in the Infuſion, or Decoction, which is then wonderfully increaſed by the action of the vital motions, and produces very ſpeedy effects.

3. But in the mean time they want that Vertue, which was contained in the Water of the firſt Proceſs, with this limitation, however, that more of it is preſerved in the Infuſion, leſs in the Decoction. This loſs however in the laſt is made amends for, by the Juices of the Plant's being rendered more efficacious

by the action of the Fire during the boiling; for by this means they are more thoroughly reſolved, and more intimately united with the Water. Hence if the Decoction is made in a Still covered with a Head, and the exhaling Water is afterwards mixed with the Decoction, then this Mixture will be very pregnant with the proper vertue of the Plant, as will appear, Proceſs 15; for in this we ſhall find almoſt all its efficacy.

4. But here we ought very carefully to conſider, that the medicinal action of an infuſion, or decoction depends as well upon the efficacy of the hot Water, and its quantity, as upon the vertues of the Plant contained in it: This the Phyſicians are well apprized of. Wou'd not a Perſon be in the wrong, who in the abuſe of Tea, ſhou'd impute all the bad effects to the Leaves only, without having any regard to the ſcalding Water which is ſuch a very great part of it? And when others aſcribe to Tea a power of rendering the Spirits agile and lively, why ſhou'd the diluting quality of the hot Water be left out?

5. Hence we underſtand the matter, and effect, of theſe Infuſions, and Apozems, and the law, method, and inſtruments, by which they ſhou'd be prepar'd for medicinal uſes; as well as the power that the hotteſt Water has upon the ſolid Parts of Plants. Who now, that had not ſeen it, cou'd have believ'd, that boiling the tender Leaves of Roſemary for the ſpace of two Days, ſhou'd not have deſtroyed them? Nay, but which is ſtill more ſurprizing, boil the ſmall, fine, Flower, as long as ever you pleaſe, and then carefully take it out, and view it either with your naked Eyes, or a Microſcope, and you'll find, that its form is not in the leaſt altered. Theſe things I have tried with a great deal of patience; and what was the effect? Why I found the Hairs, *Apices*, little Protuberances, and Lineaments to continue perfectly the ſame, without any alteration at all. Hence the Phyſicians may underſtand, why the minuteſt Veſſels of the human Body are not diſſolved by its proper humours, though they have ſo great a degree of heat in them; and hence they may learn, that the mechanical attrition ariſing from the action of the Pulſe upon 'em, is much more likely to have this effect, than the efficacy, either of warmth or moiſture. And for theſe reaſons, likewiſe, they muſt readily confeſs, that the ultimate Elements of our Bodies are not ſo much ſaline, ſaponaceous, or oily, as they are merely terreſtrial, connected and held together by a proper *Gluten*: for all that I have aſſerted of the power of boiling Water upon Vegetables, I have found to be true in boil'd animal Subſtances likewiſe, and I have publickly demonſtrated it.

6. If the Leaves, after this Operation, are dried, they appear contracted, and ſmall; but if they are again infuſed in hot Water, they very accurately recover their former ſize and figure.

7. The proper vertues of ſome Plants, however, are by thus boiling very much altered: *Arum*, if it is treated in this manner, grows mild: Aſarabacka, if it is infuſed, will vomit, as its expreſſed Juice will when it is crude; but if it is boil'd for a conſiderable time, it loſes its emetic quality and becomes a Diuretic, and Aperient.

RROCESS

PROCESS III.

A Sapa, Defrutum, *Extract,* Rob, *and Jelly from the Product of the ſecond Proceſs.*

HAVING examined in a proper manner the Infuſion and Decoction of the ſecond Proceſs, in the next place we muſt proceed to inquire, what will be left behind, when the Water that was made uſe of in thoſe Operations is again drawn off: for then we ſhall gradually diſcover what part of the Plant it was that gave them their vertues, and by this means the Chemiſt will learn, what part of it may be diſſolved in boiling Water and ſeparated from it.

APPARATUS.

1. PUT the Infuſions and Decoctions of the ſecond Proceſs into a clean Veſſel, cover them, and let them ſtand for ſome hours in a cool, ſtill place, that the Sand, and other heavy Bodies, that don't belong to the Plant, may fall to the bottom. Or, inſtead of this, they may be run through a Bag, till they become limpid; but then the gummy and ſubreſinous parts, though they are properly part of the Plant, will, by reaſon of their tenacity, be ſeparated likewiſe; and hence though theſe ſtrained Liquors may be better for medicinal purpoſes, yet for a chemical Examination they will not be ſo proper. The Apothecaries, when they want them very fine, make uſe of the following method. They take ſome Whites of Eggs, and by beating them together for a conſiderable time, mix them intimately with their decoction, and then boil them together, by which means, the Whites unite and harden in the decoction, and at the ſame time inviſcates the groſſer parts of the Liquid, which, upon being afterwards ſtrained, loſes great part of its foulneſs, and becomes ſufficiently pure. Thus then we have three methods of clarifying Decoctions: By letting them ſtand quiet; by ſtraining them; or boiling them with Whites of Eggs; of which, for a Chemical Inquiry, the firſt is moſt proper.

2. The Liquors being thus depurated, let them be put into a clean cylindrical Veſſel, or one that grows wider towards the top, and ſet upon a clear Fire, and brought to the very next degree to boiling, and thus be exhaled to the conſiſtence of a thicker Honey. And here you muſt be careful that they don't boil much, leſt any parts ſhou'd be diſſipated that ought to be preſerved; and that towards the end they don't burn, for fear of deſtroying their Vertues.

And as from theſe Infuſions and Decoctions, ſo from the freſh expreſs'd Juices of Herbs, and ſummer Fruits, in particular, or even ſucculent Roots, as Liquorice, for Inſtance, may be prepar'd the ſame Extracts likewiſe. And in this caſe, you take thoſe that are very freſh, and in their prime, clean them, pound them, expreſs their Juice, dilute it with Water, depurate it by letting it ſtand quiet, and ſtraining it, and then in the manner juſt deſcribed evaporate it to the conſiſtence it appeared of when it was firſt preſs'd. This freſh preſs'd Juice, or that which by Dilution, Colation, and Exhalation, is reduced to its natural thickneſs, we may call Muſt. Muſt, when it is boil'd to one half, which then ſtill retains its natural Taſte, and is better fitted for keeping, is called a *Sapa.*

If by boiling it is reduced to one third, it acquires the name of a *Defrutum*, from *Defervendo:* This too ſtill poſſeſſes its native qualities, and will keep longer. But when, after it is nicely clarified, it is gently boil'd, till a drop of it let fall upon a cold plate, grows of a pretty ſolid Conſiſtence, like Ice, as it were, and is very clear, then by a term borrowed from *Gelu* (Froſt) it is call'd, a *Gelatina*, or Jelly. When it repreſents a thinner Honey, it has the name of a Syrup; when a thicker, of a *Rob*, or *Rohob*. And all theſe preparations are promiſcuouſly called Extracts; which ſometimes therefore are more liquid, ſometimes leſs, and ſometimes of a hard Conſiſtence.

The NATURE, VERTUES, *and* USE *of all theſe.*

1. ALL theſe Preparations may be diſſolved in hot Water, and then reſemble the Decoctions of the ſecond Proceſs, but by boiling have loſt ſomething more of their Vertues.

2. They may be kept good for a conſiderable time, even for Years.

3. They retain a good deal of the Taſte of the Plant, though they have loſt the volatile part in the Preparation.

4. The efficacious parts of the Plant, that are now ſet free from the Confinement they were under from the more ſolid parts, and remain after the Operation, they preſerve for a great length of time uncorrupted.

5. Hence it appears, what Plants have loſt, when they come to be old, and rotten; for from theſe, Water will extract nothing at all. Nay, and dead Plants, that are alternately penetrated by the Moiſture of the Air, Dew, and Rain, and then reſolved, agitated, and dried by the Heat of the Sun, have their Juices all gradually waſhed out, and become dry and effete. The Worms too will ſo conſume the Moiſture of Plants, that when they are thoroughly worm-eaten, there remains nothing but the more ſolid parts, which are indiſſoluble, earthy, and inactive.

6. Theſe Preparations are exceeding ſerviceable in long Navigations. Sailors are liable to diſeaſes from their ſalt, dried, ſmoak'd Proviſion; and Fruits prove their cure. If they have with them therefore Jellies of Barberries, Cherries, Quinces, Juniper-berries, Lemmons, Sevil and China-Oranges, Currants, Elder-berries, or Grapes, upon diluting theſe with Water, they have at once a noble Medicine in theſe caſes. And theſe again they can recruit in a few hours time, when in their Voyage they touch upon any fruitful Iſland. This certainly is found to be of excellent ſervice both to the *Engliſh* and *Dutch*.

7. In the mean time, however, it is proper to take notice, that thoſe Juices that have a great deal of Salt in them, when they are inſpiſſated in this manner, cannot without difficulty be kept from melting in the Air. Salt is averſe to being kept dry, and is a magnet to Water. For this reaſon, who can make a Jelly from that beautiful Juice of Lemmons, that will retain its conſiſtence? Certainly, by means of the Water of the Air, it will run into a Fluid. Let the thick Juice of theſe therefore be kept in Glaſſes nicely ſtopt. Thoſe Plants likewiſe are improper for theſe uſes, whoſe medicinal Vertue conſiſts in ſome volatile part of them.

PROCESS IV.

The burning the Plant that remains after the ſecond Proceſs, now become inſipid and inodorous, though ſtill retaining its natural Figure, into Aſhes of the ſame ſhape, that have no taſte of Salt.

HAVING thus then diſcovered what happens to Vegetables from the action of a warm Air, and boiling Water, and what by this means is procured from them, let us now inquire, what effect an open Fire will have upon the parts that are left behind.

APPARATUS.

1. LET what remains of the Plant after the ſecond Proceſs, now qualify'd, as explained, *Pro.* II. *Of the Nature*, &c. No. 5, 6, be put into a clean iron Veſſel, for inſtance, an Iron Ladle. This then I now place upon a clear open Fire, where there's no Smoke to diſturb the Operation, which requires proper care, for ſomething of a ſaline nature may otherwiſe eaſily get amongſt it. In this ſtrong Fire then I keep it, till through various changes the whole at laſt grows perfectly red hot. And here you obſerve, firſt, a ſmoke ariſing of different ſorts, continually growing thicker, and blacker, and at length becoming a kind of pitchy Vapour. In the ſecond place, during all this time, it ſends forth a ſtrong ſmell of ſomething burning, which increaſes proportionably as the Smoke grows greater. In the third place, when the Vapour is exceeding black, and the Smell moſt fetid, there then at once burſts out a bright Flame, the Smoke diſappears, and the Smell grows conſiderably leſs. In the fourth place, the Herb acquires a very black colour before the Flame appears, nor will it take Fire before, tho' when it is once perfectly black, it begins to burn immediately. In the fifth place, when the Flame is over, then the Leaves have loſt their blackneſs, and are become white; and wherever in any part there is ſtill remaining ſomething of blackneſs, there the leaf ſparkles only with heat, but does not flame, and this continues ſo long as there is the very leaſt portion of black left. But when the preceding Flame and this Scintillation have conſumed all the blackneſs, there then remains nothing but white Aſhes, which cannot by any action of the Fire be made to produce Sparks any longer. And in the ſixth, and laſt place, which is the moſt remarkable of all, you ſee that though the Herb has born ſuch a violent action both of the Fire and Flame, yet the form of the Roſemary is to ſuch a degree preſerved in theſe white Aſhes, that if you examine one of the Leaves, as it lies, with a Microſcope, it diſcovers not only the original ſhape of the Roſemary, but even the Down, Hairs, Protuberances, Lineaments, and *Lacunæ*, as evidently as if the Herb was ſtill intire; and yet if you do but blow upon them, or touch them ever ſo lightly, they preſently drop into Duſt, having loſt all their coheſive Power.

2. The Aſhes, carefully prepared in this manner, I find to be inſipid, and inodorous. Theſe I put into the pureſt Rain-water in a clean glaſs Veſſel, and boil them, and then depurate the Decoction by letting it ſtand quiet, and afterwards filtering it: By this means the Liquor becomes limpid, inodorous, and perfectly taſteleſs, except that it has ſomewhat of a ſmack of boil'd Lime.

If you evaporate this Liquor in a clean Veſſel, it leaves no fix'd Salt at the bottom, but a ſmall matter of a kind of burnt Lime; and the Aſhes that remain after this Liquor is decanted, are white, perfectly inſipid, fix'd in the Fire, and merely terreſtrial, without Water, Spirit, Oil, or Salt; and if they are work'd with Water into a Paſte, reduc'd to a proper ſhape, and dried, they furniſh us with the beſt Cupels that are able to bear any degree of Fire. All now that we have here obſerv'd, holds true of every Vegetable whatever, treated in the manner propoſed, ſo that this Demonſtration is univerſal.

The USE *of this* PROCESS.

1. HENCE we learn, that Water, with the aſſiſtance of ſo much Fire as it takes in when it boils, is capable of extracting from Vegetables every thing that is ſaline, and that, both the volatile part and the fix'd.

2. But we ſee that their Oil cannot be ſeparated from them, by any Ebullition, or any quantity of Water: For the Oil, which ſtill remain'd in theſe Leaves, diſcovered itſelf; Firſt, by a thick, ſcented, bitter, black Smoke, which was afterwards converted into Flame; Secondly, by the black Colour which the Plant acquired when it began to burn, which black Colour render'd it a Coal, the Oil being torrified, made black, rarified, and more diſtributed over the Earth of the Plant by the action of the Fire, and thus diſpoſing the Plant to flame, or be ignited with a great deal of eaſe; Thirdly, by an open Flame, produc'd and ſuſtained by this black pinguious Matter, which intirely conſumed all this black Oil; and fourthly and laſtly, by that ſparkling Fire that remain'd in this Coal after the Flame was over, and there exerted itſelf ſo long as any of this pinguious black Matter was left, but that could not be excited again by any Art whatever when that was quite conſum'd.

3. Hence this laſt Oil cannot be ſeparated from a Plant, except by Fire, and that a flaming one too, in the open Air: For if with the *Reſiduum* of the ſecond Proceſs I fill this Ladle, and cover it over with an iron plate, and then expoſe it ever ſo long to the ſtrongeſt Fire, the Herb will remain black, brittle, of a bitter Taſte, will never grow white, but will become and remain a Coal; and yet as ſoon as ever you remove the Cover, it will burſt out into a flame, and will then be converted into white Aſhes.

4. We hence learn farther, that it is this Oil that connects the terreſtrial Elements into coherent *Stamina*, which are diſſolved when this is ſeparated from them; for tho' the boiling Water had extracted ſo much Salt, and Oil, in the ſecond Proceſs, yet what remained cohered together equally as before; but when once this laſt Oil was totally conſum'd, there was not then the leaſt coheſion, but the terreſtrial parts ſpontaneouſly dropp'd aſunder. The Oil, therefore, that is procured from Plants by boiling them in Water, is not that *Gluten* to which they owe their coheſion, this depending alone upon that which is ſeparated from them laſt of all. Is this laſt kind of glutinous Oil, therefore, the very ſame in all kinds of Vegetables, whilſt that which is diſſolved in the Decoction is peculiar to every particular *Species?* If ſo, then the pinguious part of Vegetables is threefold. Firſt, the oily Scum; ſecondly, the pinguious part of the Decoction; and thirdly, this conglutinating one, ſeparable only by an open Fire.

5. The other part of Vegetables, which remains after a Decoction has been made from them, is true mere Virgin Earth, ſubtil, without any Coheſion, immutable in the Fire, the ſame in every Plant, and in every quality perfectly like the Aſhes of burnt Animals, without any difference at all: This it is that gives a firm *Baſis*, both to Plants and Animals; and this procured either from one or t'other, the Aſſayers find equally proper to make their Teſts of.

6. If you mix Water with theſe looſe Aſhes, they acquire again ſome degree of Tenacity, as appears in the Teſts juſt mentioned: But if you work them with a proper quantity of Oil they cohere more ſtrongly. Oil, therefore, and Earth, compoſe the ſolid *Stamina* of Vegetables.

7. All the medicinal, nutritive, and poiſonous qualities of Vegetables, reſide abſolutely in that part, which, by Decoction with Water, may be extracted from them; and the conglutinating Oil that then remains with the terreſtrial Elements, has nothing at all ſingular in it, nor the Earth when it is quite alone.

8. The longer, therefore, Plants are a drying, and the drier they are, ſo much the more they proportionably loſe of their Vertues: Nay, this is true to ſuch a Degree, that if any Plant whatever is for a long time expoſed to the open Air, there remains nothing at laſt but mere inactive Earth.

9. Hence it comes to paſs, that Plants are able to bear the actions of a moiſt Air, Dew, Rain, and the Sun, without being deſtroyed, if they can but be ſupplied with freſh nouriſhment from the Earth: And hence it happens, that boiling Water, let it boil ever ſo ſtrongly, is not capable of diſſolving the moſt tender Flower, as it cannot ſeparate this laſt conglutinating Oil from the Earth. It is the Earth, therefore, alone, that gives them all a firm *Baſis*.

10. In the ultimate ſolid *Stamina* of a Plant, therefore, there does not reſide any Salt; and conſequently in thoſe you will ſeek for it in vain. And all this holds good likewiſe in the ultimate Solids of Animals.

11. The free admiſſion of the Air, renders Fire capable of ſeparating this ultimate Oil from the Earth; nor is the Fire alone, without the aſſiſtance of Air, capable of effecting this, no not even in thoſe parts that are the moſt tender.

PROCESS V.

The Preparations of the third Proceſs being burnt, yield Aſhes that are ſalt.

HAving ſeen what effect an open Fire has upon the remainder of the Plant after the ſecond Proceſs, we muſt now examine, what will be the conſequence of applying the ſame to the Infuſions, Decoctions, and Extracts prepar'd by the third; that by thus again, comparing the effects of the laſt Proceſs with this, we may underſtand the proper power of Fire upon Plants. Pleaſe therefore to give your Attention.

APPARATUS.

1. LET the Extracts prepar'd by the third Proceſs, be gently dried in a clean iron Ladle, with a very clear Fire; and they will then be black, ſhining and tenacious. When they are reduced to this condition, if they are urg'd by a ſtronger Fire, they ſmoke, and continue to do ſo more and more,

till at laſt, when the Ladle begins to grow red hot, they diffuſe a ſtink of ſomewhat burning, emit a very black, bitter, thick, Vapour, and then burſt out into a Flame, upon the ceaſing of which, the Matter that remains, continues to ſparkle wherever there appears any blackneſs, which being conſumed, it moulders into Aſhes of a pale yellowiſh Colour, tho' before it was exceeding black.

2. If you keep theſe Aſhes a good while in the Fire in the Ladle, they grow ſomewhat white, remain fix'd, and have no ſmell, but are ſalt, having an acrid, lixivious, ſub-urinous Taſte, and if they are put upon the Tongue in theſe circumſtances, they leave upon it ſomething of Earth. If they are diſſolv'd in pure Water, and then filter'd, inſpiſſated, and dried, they yield a yellowiſh white Salt that is acrid, igneous, and lixivious, and of a ſub-urinous Taſte. And here we obſerve a difference, both in the degree of Acrimony, and the quantity of Salt, ariſing partly from the various natures of the Plants treated in this manner, and partly from the different degrees of Fire made uſe of in the Operation.

USE.

1. BOiling Water, therefore, diſſolves the Oil and Salt of Plants, and that Earth which is moſt intimately united with them.

2. But this Oil being compounded with the Salt of the Plant into the form of a Soap, may, in the Plants, be perfectly mix'd with Water; and hence we have an idea of their native ſaponaceous Juice.

3. The Water being ſeparated from this natural Soap, the Oil of it, which is inflammable, grows black when it comes to be expoſed to a ſtronger Fire, rarifies, is diſtributed over the ſurface of the Salt, is kindled into a true Flame, conſumes, and then there remains the Salt, depriv'd of this Oil: Here, therefore, there ariſes a true vegetable Coal from Water, Salt, and Oil.

4. This Oil it is, that gives the Extract its Colour, and produces the denſe, black, fetid Vapour, as well as the black Colour the Extract acquires at the Fire, and the ſmell of the Plant, if any happens then to remain; and this is the only inflammable part.

5. If the Water of the firſt Proceſs, the Infuſion of the ſecond, and the Salt prepar'd by this fifth, are mix'd together, they make a Compound, whoſe medicinal Vertues are very conſiderably efficacious.

6. When you make uſe of Plants for this Operation, that are very acrid, and poſſeſs an igneous, volatile quality, diſcovering itſelf by making the Eyes water, the very ſame things happen as we have deſcrib'd; but then there ſcarcely remains any Salt in their Aſhes, this, in them, being of a volatile Nature. This we ſee evidently in Onions, Scurvy-graſs, Horſe-radiſh, Muſtard, and many others.

PROCESS VI.

The freſh Plant, or the Reſiduum *of the firſt Proceſs being burnt, produces ſalt Aſhes.*

APPARATUS.

1. LET it be put into a clean iron Ladle, and ſet upon a clear Fire, without any Smoke, which muſt be gradually raiſed by very gentle degrees. In the firſt place, then, there will ariſe a Smoke, which will diffuſe a ſmell of Roſemary, will be watery, without colour, or ſub-pellucid, and will continue till the Plant begins to be almoſt black. In the ſecond place, when it is become black, there iſſues out a thicker, blacker, and more fetid Smoke, and then the whole becomes black like a Coal; and preſently after it breaks out into Flame, burns, ceaſes to ſmoke, and when the Flame is over, ſhines and ſparkles, and there remain at laſt the white *Exuviæ* of the Herb in their proper ſhape, as in the fourth Proceſs, nor as yet to be diſtinguiſhed from them by any mark whatever. Hence, therefore, the Oil of the Plant always grows black, when it is expoſed to the action of the Fire, whether it is carried up out of the Fire and agitated in the Air, and produces a pitchy Smoke; or is ſpread over the Earth, or Salt, or both together, and diſcovers itſelf by its ſparkling; or whether this black oily Smoke is lighted by the Fire, or being very rapidly roll'd about conſtitutes the Flame, from which, when it extricates itſelf, it produces a black Soot, and thus evinces, that a lucid Flame is an Oil rendered black, and whirl'd about in the Fire. And as ſoon as ever the Matter that thus grows black in the Fire is abſolutely conſum'd, then neither Flame nor Sparks can be procur'd from it any longer by any contrivance whatſoever; but then every part of the Plant, without exception, becomes white.

2. The Aſhes prepared in this manner, if they are made from the fine parts of Vegetables, retain their figure to the greateſt Exactneſs, tho' they have born this violent action of the Fire: But when a very thick part of them is burnt, then the whole grows perfectly black, and becomes a Coal, of which that part only which is next to the Air is firſt conſum'd by the Fire into white brittle Aſhes, and then the black *Stratum* under theſe burns away in the ſame manner, and ſo on ſucceſſively, by which means it happens, that the Figure, whilſt it is burning, is deſtroy'd, the action of the internal combuſtible parts, protruding from the Center the external ones that are now turn'd into Aſhes; which does not happen, if the ſubſtance that is expoſed to the Fire is but thin. If theſe Aſhes are applied to the Tongue, they impreſs upon it an acrid, igneous, lixivious, urinous Taſte. If they are diluted in pure Water, and then filter'd, and the Liquor is evaporated, it leaves a Salt, as in the fifth Proceſs, but in much leſs quantity, and there remains in the filtering Bag a large quantity of pure Earth, ſuch as was procured by the fourth.

USE.

1. WAter, with the aſſiſtance of Fire, diſſolves only the Juices of Plants, leaving their proper ſolid parts unaffected.

2. Fire itſelf is ſcarce able to effect any thing more, and when it acts alone really extracts leſs from them, inaſmuch as it ſtill leaves a Salt.

3. Water ſeparates a great deal of their combuſtible matter, which being left behind diſpoſes them to burn more powerfully.

4. The ſaline parts of ſome Plants are not rendered volatile by Fire, but only the Oil that adheres to them.

5. The Oil and Salt that are naturally mixed in Plants, are diſſoluble in Water, and remain united together, but are ſeparated by Fire.

6. In the humours, therefore, both of Animals and Vegetables there is a native *Sapo*, whilſt they are in a ſound ſtate; but if the Oil or Salt that compoſe it exiſt there by themſelves, they both become diſeas'd. Thus, as the great *Hippocrates* obſerves, Bodies, when they are mixed together, often conduce to health, though they prove noxious when they are aſunder.

7. The eſſential difference betwixt Plants conſiſts in their Juices alone; the Earth and conglutinating Oil being common to all.

PROCESS VII.

The Native Salt of Plants procured from their Juice freſh preſs'd: An Inſtance in Sorrel.

THE preceding Operations have taught us, what are the Effects of Air, Water, and Fire upon both the Solids and Fluids of Plants, and what parts thoſe are which are procured from them, and into which they are reſolved by means of theſe Inſtruments; and have given us beſides one *Species* of fixt Salt produced from them. But now we muſt more accurately examine, in what form the Salt of Plants does actually exiſt in their native Juices, of what Principles it is there compounded, and what particular Qualities it then diſcovers, that by this means we may properly diſtinguiſh betwixt thoſe Vegetable Salts that are naturally generated in the vegetable Kingdom, and thoſe which are produced by a chemical Fire; for this, it is of conſiderable conſequence for us to be acquainted with. The method however of procuring theſe Salts I cannot poſſibly go through before you here, as the Proceſs will take up the ſpace of ſome months before it is finiſhed: The beginning therefore and end I'll exhibit to you, and the reſt I'll ſupply by Deſcription; and hence you will be able to diſcover what a prodigious difference there is betwixt theſe native Salts, and thoſe produced by Fire. And this I deſire you will particularly take notice of, as nothing has given occaſion to groſſer Errors than a Notion. that is got among the Chemiſts, that Salts exiſt exactly in the ſame manner in the Plants themſelves, as they find them when they have procured 'em from them by the Torture of the Fire. If we would proceed with caution here, certainly, we cannot conclude, that ſuch a particular Salt was actually in the Plant, becauſe, by the aſſiſtance of Fire we have produced it from it. No, according to the Rules of Art, we can only reaſon thus: With a determin'd degree of Heat, I procured from ſuch a Plant, ſuch a Salt, and conſequently there was naturally in ſuch a Plant ſome Matter, which being treated in that manner, yielded that Salt; and no farther. Upon examination, now, we ſhall find, that the combuſtible, pinguious part, accurately united with the pure ſaline one, will give the native Salt.

APPARATUS.

1. I TAKE a large quantity of broad leav'd Garden Sorrel, pull'd out of the ground betimes in the morning, now it is in its prime, and juſt ready to flower. This I waſh in a running Stream from all the Mould and Sand that hangs about it, and then cut it, pound it, and put it into a hempen Bag, and preſs out as much Juice as is poſſible; which will be very acid, green, and as thick as Muſt.

2. This Juice I dilute with ſix times as much very clean Rain-water, that it may more eaſily paſs through the filtering Bag.

3. This diluted Juice I pour into a conical Linnen Bag, and when it is run through, pour it back again, and repeat this till it becomes a limpid, pure, thin Liquor; which will then be gratefully acid.

4. The Liquor thus depurated, I put into broad glaſs Veſſels, and by boiling it very gently in a place that is not duſty, and with a Fire that is not ſmoky, I inſpiſſate it till the remainder acquires nearly the conſiſtence of new Cream: This will be exceeding acid.

5. This inſpiſſated Liquid I pour into a very clean Urinal, ſo that it may riſe a little into the Neck, and then very gently pour ſome pure Oil of Olives upon it, to the thickneſs of a line, which being done, I ſet it by in a Cellar on a Pavement, where it muſt ſtand quiet for the ſpace of eight months. By this means, then, under the Oil which prevents any Fermentation, Putrefaction, or Production of Mucilage, there is generated a Salt reſembling a kind of Tartar, which, when the Liquor that ſwims at top is decanted, comes as near as poſſible to the native Salt of the Plant.

6. This Salt, if it is ſlightly waſhed with cold Water, as expeditiouſly as poſſible, from the mucilaginous impurities that adhere to it, and is then gently dried, gives you the native Salt of the Plant, which I have never diſcovered to be alcalious in any Plant whatever, when it was thus contained in the Juice, diſengaged itſelf thence, and became concreted into ſaline Maſſes. If you compare this, now, with the Salt produced in the fifth and ſixth Proceſs by an open Fire, you will find a prodigious difference in the Colour, Taſte, Figure, and all its effects, both phyſical and medicinal. This is purely ſeparated from the native Juice of the Plant; that is the proper production of the Fire, not exiſting in the ſame manner in the fluids of the Plant, but being, as *Van Helmont* very juſtly expreſſes himſelf, a New Creature.

7. The Inſtance I have here given is in Sorrel, but you may perform the ſame Operation upon any other ſucculent Plant whatever, though you will always have a Salt of a different nature, according to the various Plants you make uſe of. If the Juices have a manifeſt pure acid taſte, or an auſtere acid one, then the Salt thus procured will be like the Tartar generated in an acid, or rough Wine. But if you treat in this manner Plants that are exceeding ſucculent, but neither acid nor oily, as a great number of the medicinal ones are, then the Salt produced will be of another nature, proper and peculiar to them, and approaching perhaps nearer to Nitre. Brooklime, Succory, Dwarf-Elder, Endive,

dive, Fumatory, Graſs, Water-Creſſes, Water-Lilies, Plantain, Knot-graſs, Self-heal and Dandelion yield ſuch a kind of Salt. And hence the Juices of theſe Plants, on account of the large quantity that they contain of this ſub-nitrous Salt, are endued with excellent medicinal vertues, make their way thro' Veſſels that have been long obſtructed, reſolve the pitchy Tenacity of the black bile, and prove powerfully efficacious in ſtubborn chronical Diſeaſes. But again, if for this purpoſe, you make uſe of Plants whoſe Juices are viſcid, and glutinous, as we ſee in Purſlain, the Seeds of Fleawort, and the greater Comfrey, you never will procure a Salt from them till their tenacity is deſtroyed by a previous Fermentation. And in the ſame manner, all thoſe Juices, in which there is a large quantity of Oil, are unfit for this Operation; for though they actually contain a ſaline matter in them, yet this is ſo inviſcated in the Oil, that the particles have not power to unite together into chryſtalline Glebes, as Oil always prevents the formation of Chryſtals in any Salt whatever. And beſides an abundance of Oil always occaſions a deficiency of Salt, both in Animals, and Vegetables; and the contrary; for which reaſon you can ſcarce procure any of this Salt, from Plants that are full of rich aromatic Oils, or Balſams.

USE.

HENCE then we learn the nature of the Salt, thus prepared, which is the true native Salt of the Plant. This is diſſoluble in Water; is compoſed of an oily, and ſaline principle; is often acid; never alcalious, for where there is any ſuch Salt, that flies off in the boiling and inſpiſſation; moderately fix'd; eaſily mutable; miſcible with the human Fluids; and capable of penetrating into thoſe Veſſels of the Body that are conſiderably ſmall, and hence of exerting its proper Power there. If it is dried, it is partly combuſtible, as the inſpiſſated Subſtances in the fifth Proceſs, and then it is converted into ſuch a Salt as was obtained by the fifth and ſixth.

PROCESS VIII.

The Native Salt of Plants procur'd from their fermented Juice, call'd Wine-Stone, or Tartar.

THE preſs'd Juice of ripe Summer Fruits, being perfectly fermented, and hence acquiring the name of Wine, by ſtanding only, depoſites its Lees, call'd the (*Mater*) Mother of the Wine, and becomes fine. If it is then drawn off into another Veſſel, in time it generates little corpuſcles, which move about in the middle of the Liquor, ſhine, gliſſen, are ſharp and ſubtil. And theſe being afterwards diſpers'd from the center of gravity of the Wine towards every point of its ſurface, faſten to the concave ſurface of the Cask, and by this means incruſtate every part of it, where the Wine can come at it. The Wine then continues gradually to diſcharge more and more of the ſame matter, which very eaſily adheres to, and is attracted as it were by the former, and this goes on till the Body of the Wine at laſt contains no more of it. If the Wine, now, having thus depoſited all the matter of this kind that is contained in it after Fermentation,

mentation, and being by this means grown ſofter, is drawn off into another Cask, and the former is fill'd again with Wine, not yet fined, this will ſtill add more of the ſame matter, which will be ſooner generated than the other was, being attracted to the ſides in a ſhorter time by the efficacy of the cruſt already form'd. And this is the real Production of that ſurprizing Body, which is a true ſaline Chryſtal of Wine, but not form'd only at the bottom, as other ſaline Chryſtals are, but equally in every part of the ſurrounding Veſſel. This, in a great many of its properties, is perfectly diſtinct from the Lees of Wine, tho' it comes in its nature pretty near them. This is more ſubtil, purer, leſs terreſtrial, not ſo foul and oily, is diſſolved in Water with more difficulty, and is of a more acid Taſte. This the *Germans*, by a very expreſſive Term, call Wine-Stone; The Chemiſts, not ſo properly, Tartar. There is a vaſt deal of difference now in this, according to the various Wines from which it is generated. Acid and rough Wines yield more of it; ſweet, ſoft ones, leſs. Wines that are prevented from thoroughly fermenting, too, produce a ſmaller quantity; thoſe which are become very ſubtil, by means of a perfect Fermentation, a greater; as we ſee in the *Rheniſh* Wines. Red Wines generate Red Tartar; White ones, White.

USE.

THIS is a ſecond Method then of obtaining the Native Salt of Vegetables, which is always acid, oily, and very eaſily converted into an Alcali. It will diſſolve neither in Water, Wine, nor Vinegar, without the aſſiſtance of Heat, but remains like a Stone unaffected; nay, in the ſame manner as a ſtrong Veſſel does, it contains the very Wine from which it was generated. If you wou'd diſſolve it in Water, in order to do this, you muſt make it boil, and then as ſoon as ever the Water grows a little cooler, it hardens again in the Water, and acquires the name of Cream, or Chryſtals of Tartar. And even when the Water does boil, it requires twenty times its weight of Water to diſſolve it, otherwiſe it will remain at the bottom. Whilſt it is burning in the Fire, it produces more elaſtic Air than any other known Body, and generates a Vapour that is abſolutely incoerceable. Where a Perſon is troubled with a bilious, acrid, putrid diſorder, it is an excellent Corrector; and hence in acute Diſtempers it proves a valuable Medicine. It gently opens and purges the firſt Paſſages, without cauſing any conſiderable diſturbance in the internal parts. If it is mix'd with an acrid putrid Matter, it loſes its acidity, and becomes a noble Aperient. Its other properties will appear, when we come to treat of it in Proceſs 54, and 55. Thus then we ſee, what Sort of Salt is found in the native, and fermented Juices of Vegetables. But in the 55th Proceſs, I ſhall demonſtrate before you, that theſe Salts may be eaſily reſolv'd into a vaſtly elaſtic Air; an acidiſh Water; an acidiſh fetid Spirit; a volatile Oil, the moſt penetrating of any we are acquainted with, and exceeding volatile; an Oil thicker, and more fix'd; a black alcaline Coal; an excellent Alcali; and an Earth. Salts, therefore, do not exiſt ſimple in Plants, but are temper'd by the admixture of other Bodies: And thus you begin to underſtand the Chemical *Analyſis* of Vegetables.

PROCESS IX.

Salt procured from green Roſemary, by burning it after the Method of Tachenius.

APPARATUS.

1. INTO a large and pretty deep iron Frying-pan, I put a quantity of clean, dry, freſh, green Roſemary, both Leaves, and Stalks. Upon this I put an iron Plate, which muſt lay upon the Roſemary in ſuch a manner, as to preſs it down, and perfectly cover it all over. This being thus diſpoſed, I place the Pan upon a gentle Fire, which I increaſe by degrees till the Pan grows perfectly red hot. The Plant, by this means, will ſmoke, diffuſe a Smell, and be converted into a Coal. I then add more freſh Roſemary to the former, cover it, preſs it down, and proceed as before, till this is turned into a Coal likewiſe: And this I repeat, till I have got a quantity ſufficient for my purpoſe. And during this Operation, I take all poſſible care that the Herb ſhan't take Fire, and flame, which is beſt prevented by covering it in ſuch a manner, that it has no communication at all with the Air, for if that comes to it, it breaks out into a Flame, which in this caſe does harm. This is call'd the Uſtulation of a Plant, and the ſlower and more gradually it is perform'd, the Operation will be proportionably more perfect. When this caution, then, is obſerved, the Herb will be very black, brittle, and bitter; and if it is boil'd in Water, it will yield a Decoction, that ſcarcely yet diſcovers any Salt in it, but taſtes burnt and bitter, and proves a ſudorific: So that in the Uſtulation of a Plant into a Coal, there hardly appears any Salt, either by making a *Lixivium* of it, or by applying it to the Tongue.

2. The firſt part of the Operation being properly perform'd, take away the iron Cover, and let the Frying-pan, with the uſtulated Herb remain on the ſame Fire; upon which, as ſoon as ever the Air comes to it, the Herb, which is now become black, will take Fire, and would very eaſily riſe into a Flame; but this muſt here be carefully prevented, and the ignition only muſt be kept up with a moderate Fire. You ſee then, when the upper part, which is contiguous with the Air, has for ſome time ſparkled and ſhined, its Fire goes out, and then it preſently grows white. The parts, however, that are cover'd with theſe white Aſhes, will ſtill remain black, and on fire, and therefore all the Herb muſt be gently ſtirr'd about with an iron Rod, that every part may be ſucceſſively expoſed to the Air, and become white, till the whole being thoroughly on Fire, and by this continual agitation being a proper time expoſed to the Air and Fire together, is converted into one homogeneous white Maſs, which is then but in ſmall quantity, heavy, and equally white. And when this is the caſe, there is no ſuch thing as raiſing a Spark in it again, by any Fire whatever; tho' if there is but one black leaf in it, that, as ſoon as ever it comes to the Air, will take Fire in the ſame manner as the reſt did. When the whole Herb now is thus reduced to a whiteneſs, it has then an acrid and ſomewhat urinous ſaline Taſte, which never appears in the Herb, as long as that black part, which is a pure inflammable Oil, continues to adhere to it; but as ſoon

as ever this is intirely conſumed, then the Salt, which is unaffected by the Fire, begins to diſcover itſelf. Hence then it appears again, that the conſumption of the Oil is neceſſary, before the Salt can be procured.

3. Let the Aſhes thus prepared, be left an hour or two upon the Fire, and let them be kept conſtantly red hot, and continually ſtirred with an Iron Rod; and this compleats the Calcination of Herbs for *Tachenius*'s Salt. In this Operation now the action of the ſmothering Fire in the firſt ſtep, after it has expell'd the Water, intimately unites the ſaline and oily principles into a ſulphureous ſaline Concrete, to talk in the Language of the Artiſts, which is in ſome meaſure of a ſaponaceous nature, but which, at the ſame time, has a large admixture of a very ſubtil Earth.

4. If you put theſe Aſhes into a clean Iron Veſſel, with ſix times as much pure Rain-water, and boil 'em, ſtirring 'em now and then with an Iron Ladle, then the Liquor that ſwims at top will be acrid, lixivious, and ſaline, and will have drawn great part of the Salt out of the Aſhes, leaving the Earth at the Bottom. Let this be poured off and filtered boiling hot, till it becomes perfectly limpid, and then let it be ſet by, under the Title of a *Lixivium* of *Tachenius*'s Salt. If the Earth that remains at the bottom of the Veſſel, or in the Bag, is boiled again with freſh Water, it will ſtill yield a farther *Lixivium*, but the Taſte of this will more reſemble the Acrimony of Lime, and will contain leſs Salt: This may be filter'd too, and mix'd with the former. Let the Earth that is left behind be boil'd with more Water, and the Liquor poured off as before, and this be repeated till the laſt Water comes off as inſipid as it was put on. Theſe laſt *Lixiviums*, too, may be depurated and kept, or you may throw them away as of little conſequence. Let the Earth that remains be ſhook about with Rain-water, let this, when it is become turbid, be poured off, and proceed in this manner, till the Sand, which alone will ſink to the bottom, is perfectly ſeparated from the true Aſhes which will be diſperſed through the Water. Let theſe turbid Waters be mixed together, and ſuffered to ſettle, and there will fall an Earth to the bottom, which being dried, is a pure Vegetable, Elementary Earth, almoſt a Virgin Earth, and exceeding fit for making Cupels with.

5. Let the pure *Lixivium* abovementioned be evaporated in a clean Iron Veſſel, till it is become quite dry, keeping it continually ſtirring about towards the end, to prevent its ſticking to the bottom; and by this means you will have a browniſh Salt, that will be acrid and ſomewhat alcalious, and will gradually diſſolve in the Air, but yet not ſo readily as a perfect Alcali: And here you may obſerve, that the browner this Salt is, the more properly will it be prepared; for it will have ſo much the more of the Oil in it.

6. If this Salt is put into a clean Crucible, and ſet in a Fire every way ſurrounding it, till the Crucible is red hot, it will eaſily enough flow like Water, much ſooner than a true fix'd alcaline Salt; and then it muſt be pour'd out upon a clean braſs plate in form of little cakes. And thus you have the pure fixed Vegetable Salt of *Tachenius*. If any perſon has a mind to render this ſtill purer, he may expoſe it to the moiſture of the Air, or diſſolve it in Rain-water, and after he has depurated the Liquor by filtration, and letting it ſtand quiet, inſpiſſate it 'till a pellicle appears on the ſurface, and then, by ſetting it by in a ſtill place, it will ſhoot into ſaline glebules, which are the pureſt chryſtals

of all, but ſufficiently expenſive. In theſe there is not contained an acrid Alcali, but the Oil of the Plant, being mixed with alcaline Salt, renders it more mild. You muſt not imagine, however, that the peculiar vertues of Plants is preſerved in the Salt prepared in this manner; for the Fire has expelled this with the *Spiritus Rector* which is too volatile to be retained in ſuch a degree of heat. And hence the commoneſt Herb, if it has but a good deal of Salt, being treated in this manner, yields as good a Salt of this Kind as the moſt valuable: Its medicinal effects certainly will be found to be the ſame. But here let me caution you, that the colour of this Salt will be very eaſily chang'd, if a Coal happens to fall into it whilſt you are melting it, for then it immediately acquires a leaden Colour, which will vary according to the quantity of the Coal that comes amongſt it.

USE.

1. THESE Salts are not acrid, nor igneous, but are a ſaline compoſition of an Oil cloſely united by the Fire with an acrid Alcali; and they are ſo much the more diſtant from an acrid alcaline cauſtic quality as the Herb undergoes a longer uſtulation, and as you more accurately prevent any Air's coming to it during the Operation: And then on account of their medicinal Vertues too, they are proportionably the more valuable.

2. They are not therefore in their nature ſo contrary to an acid, as to deſtroy ſo great a quantity of it, as pure Alcali's do, if they are mixed with it in the ſame proportion. Nay if they are properly prepared, they may in ſome meaſure ſupply the want of Sea and Foſſil Salt for the common uſes of Life; as *Varro* tells us of the Inhabitants of the *Rhine* who inſtead of 'em, made uſe of a Salt procured from the Coals of ſome ſorts of Wood *de Re Ruſtica.* L. I. C. 7.

3. If theſe Salts are put into open Veſſels, and are expoſed to the external Air for a conſiderable time, they will melt with the Water they draw out of it, but ſlower and with more difficulty than pure Alcali's; but in Water they diſſolve immediately.

4. They have this particular in them likewiſe, that they will readily mix with all the humours of the human Body, nay even with the pinguious Oil, and the inſpiſſated Bile, that is to ſay, with the aſſiſtance of the vital warmth, and the action of the circulating Fluids.

5. Hence they are capable of penetrating into the ſanguiferous, ſerous, lactiferous, lymphatic, urinary, ſudoriferous, and bilious Veſſels; but they will not be admitted within the nervous.

6. When they are mix'd and diluted with the animal Fluids they are able by the concurrence of the natural Heat and vital Actions, to reſolve various kinds of Concretions, nay, indeed, the principal that are obſerved in our Humours; eſpecially if they are rendered more efficacious by Friction, Riding, or other moderate Exerciſe. Stones in human Bodies they don't eaſily diſſolve by the proper power of a *Menſtruum*, but they leſſen them, by the mechanical Motion, and Attrition, which they increaſe in the Body, particularly in the urinary Paſſages. The Diſorders in the Juices of the Nerves they are not able to reach, and hence cannot directly cure a true Gout; but otherwiſe, when they are diluted

with warm Water, and aſſiſted with motion, they become conſiderably penetrating, even into the moſt intimate parts of the Body.

7. When theſe Salts are received amongſt, and mix'd with our Humours, they there act with an Acrimony that is not deſtructive, indeed, but that exceeds their natural ſoftneſs, and hence they irritate the ſenſible parts of the Nerves, and by their ſtimulations, make them perform their vibrations with a greater *impetus* than uſual; and on this account, they are of excellent ſervice where a *Stimulus* is wanting in a languid habit of Body, in ſlow Hypochondriacal, and Hyſterical Diſorders, and others that ariſe merely from inactivity.

8. They prove admirably efficacious, therefore, in opening the obſtructed Veſſels of the human Body, both as they ſtimulate the whole nervous Syſtem, and at the ſame time, diſſolve any of the Fluids that are grown too thick, and by their weight too, which is greater than that of our native Salts, urge all the parts with an *impetus* ſomewhat greater than what is natural.

9. Hence they have a power of promoting all the Secretions, and Excretions; for at the ſame time that they render thoſe Humours ſufficiently fluid that were not ſo before, they clear the Veſſels too from their obſtructions, and by their irritation ſtimulate them, and make them propel their contained Fluids with a greater velocity; and hence they equably excite the true cauſes of the motion of our Fluids through their Veſſels, on which depend all the Secretions and Excretions in every part of the Body.

10. Hence, then, it appears, why theſe Salts are a Sudorific; for ſince it is evident, that the Sweat naturally contains in it the native Salts of the Body, and depoſites them on the external ſurface of the Cuticle by means of little Arteries that open there, certainly this way will be ready for theſe Salts likewiſe, and here will they exert their power; and this is beautifully confirmed by Experiments. But theſe Salts, in particular, cauſe a more plentiful diſcharge of Water; for the Author of Nature has form'd the Kidneys principally to carry off the Salt of the Humours when it is in too great a quantity: This, the Urine, which of all the Fluids is much the ſalteſt, ſufficiently evinces. And hence the efficacy of theſe Salts is never more manifeſt than in their Operation by Urine, and at the ſame time purging the Humours from any noxious impurities with which they are loaded. They help to diſcharge too the harder Excrements by Stool, inaſmuch as they are able to reſolve them, open the Paſſages, and ſtimulate the Inteſtines, when they perform their office too ſlowly. In hypochondriacal Perſons, certainly, where the Body is very coſtive, you will ſcarcely find any Medicine more efficacious than theſe Salts, directed in a proper manner and quantity, and continued in for a ſufficient time. And in this caſe, they have this particular excellence, that when you leave them off, the Inteſtines continue regularly to diſcharge their contents, without any coſtiveneſs, which is not the caſe with many other Purgatives. And as for the bilious Syſtem, the Liver, Spleen, Gall-Bladder, paſſages of the Bile into the Inteſtines, and *Vena Porta*, with what Medicine can they be more ſafely and efficaciouſly freed and purged from any Obſtructions, or noxious Humours, than by this? By this lixivious *Sapo*, certainly, are reſolv'd any tenacious concreted ſubſtances in the firſt paſſages, whence follows a thorough purgation without violence or danger; ſo that here we have, according to the advice of *Hippocrates*, a proper Coction, and Preparation of the Matter to be purg'd off.

11. Hence, therefore, theſe Salts prove of excellent ſervice in all Chronical Diſtempers, where there is a mere *Torpor* of the Spirits, too great a laxity of the Fibres, and a ſluggiſhneſs of the Fluids, without any putrid Acrimony, an acidity from a weakneſs of the vital Powers, or a *Coagulum* from an auſtere Juice, or an acid one. If Phyſicians, therefore, will but conſider what a great number of Diſeaſes depend upon theſe cauſes, they will make no ſcruple to believe that many chronical ones may be cur'd by the Salts prepared in this manner, which deſtroy Acids, convert them into neutral Salts, and then diſſolve thoſe Fluids which are grown too tenacious, and at the ſame time, by their moderate *Stimulus*, gently increaſe the actions of the Veſſels. Do not hence, however, imprudently conclude, that the uſe of theſe Salts is always beneficial, and never hurtful. On the contrary, in caſes where the Humours are putrid, bilious, alcaleſcent, circulate too quick, and hence are too hot, theſe Salts only add Oil to the Fire: Nor are they leſs hurtful to Perſons whoſe Conſtitutions are ſo tender, that they are not able to bear the effect of them; for then the motion they excite proves deſtructive. Where there is a great quantity of Salt too already in the Body, theſe, if they are ſuperadded, prove detrimental.

The Method of uſing theſe SALTS *in Phyſic.*

1. THEY ought to be taken when Digeſtion is compleated, and the Stomach is empty, and conſequently, about ten hours from the laſt meal. As for the quantity, they may be given, according to the circumſtances of the Perſon they are preſcrib'd for, from four Grains to 2 Drachms, or more, which muſt be left to the judgment of the Phyſician.

2. They ſhou'd be diluted in a good deal of Water, leſt, if they ſhou'd be drank too ſtrong, they ſhou'd injure the *Fauces*, *OEſophagus*, and Stomach. Let a Drachm of this Salt, therefore, be diſſolved in 9 Ounces of common Water, and then it will act like the medicinal Springs, which, in proportion to their Water, contain but a ſmall quantity of Foſſil Salt.

3. If the Phyſician has a mind to purge his Patient, let him take, going to Bed, 9 Grains of waſh'd Soccatrine Aloes made into 3 Pills, or half a Drachm of *Pil. Ruf.* and the next morning let him riſe pretty early, and walk about in a cooliſh Air, taking care he don't ſweat, and whilſt he is walking, let him take a proper quantity of theſe Salts divided into five or ſix Doſes. This Method will have a very good effect, for the Body will be purged and lighten'd, and not much debilitated. This is the true Medicine for the Coſtiveneſs of ſedentary learned Men, and extirpates diſorders ſo deeply rooted, that they prove ſtubborn to all other Purges.

4. If you have a mind rather to purge the ſanguiferous Veſſels, and to have a diſcharge by the Kidneys, with the cautions firſt given, omit the Aloes in the Evening, let the Loins, and the Hypogaſtric Region be kept warmer than the other parts of the Body, and let the Patient now and then drink a draught of warm Tea or Coffee.

5. If Sweat is to be procured, let the Patient take theſe Salts in Bed, and after every Doſe let him ſup ſome gentle Sudorific, as a Decoction of Burdock Roots, the five opening Roots, Santals, Saſſafras, Tea, or Coffee; and with

a ſufficient quantity of Clothes upon him, let him ſweat according to the nature of the Diſtemper.

6. If you want to cure Autumnal, Tertian, or Quartan Intermittents, this will be beſt effected by purging two or three Days ſucceſſively, according to the third Obſervation. Then about 4 hours before the Fit, let the Patient be gently ſweated according to the fifth; but with this circumſtance, that the Sweat may be greateſt about the time of the Paroxyſm. In this manner, very ſtubborn Agues are happily cured. And in this reſpect, a *Lixivium* of theſe Salts excels even the *Acidulæ*, and *Spaw* Waters.

PROCESS X.

Tachenius's *Salt procured by Fire from a dry Herb: Here from* Carduus Benedictus.

APPARATUS.

IF this Plant, with the ſame *Apparatus*, as in the ninth Proceſs, is uſtulated over the Fire, and equably burnt into very black Coals, and you collect a large quantity of theſe, and ſet them upon the Fire uncover'd, and convert them into Aſhes that are every where white, without the Herb's ever flaming; then by calcining theſe Aſhes for a ſhort time, making a *Lixivium* of them, depurating it, procuring a Salt from it, and then melting it, you will have the very ſame Salt from this dry Plant, as you had in the former Proceſs from the green one.

USE.

AS in theſe Salts, the Oil and Salt, common to a great number of Plants, are combined without the native quality of the Plant's being preſerv'd; hence it is evident, that it is of very little conſequence from which they are prepar'd, the thing coming to the ſame at the end. For this purpoſe, therefore, one may make uſe of the commoneſt ſorts of Plants, and thoſe that are good for nothing elſe. Thus, if after you have gathered your garden Beans, you take the Stalks, ſlightly dry them, lay them in a large heap, preſs them down by laying iron Plates upon them, and uſtulate them with a gentle Fire, you will procure a very good Salt of this kind, that will come very cheap, and will in vertue be equal to that prepar'd from Herbs that are more valuable. The making of theſe, therefore, I recommend, on this account only, not that it has any particular qualities, tho' *Paracelſus* extolls it mightily above others for its excellence againſt the Stone. Let me caution you, however, that the Plants you make uſe of are not too old and dry, for in that caſe they won't yield Salt enough to pay you for your trouble: Otherwiſe the Preparation of dry ones is more expeditious, eaſier, and cheaper.

PROCESS XI.

Salt prepared from burnt Vegetables, in the manner that is commonly practiſed by the Apothecaries.

APPARATUS.

TAKE any freſh Plants that abound with a ſaline Matter, as Wormwood, *Carduus Benedictus*, Glaſs-wort, Fern, Bean-ſtalks, or the like; let them be dried in an Air that is hot and dry, and by ſhaking, be freed from the Sand and Mould that hangs about them; then let them be made up into large bundles, and be diſpoſed into a Pile upon a flat pavement in the open Air, and ſo ſet on fire, upon which they will break out into a crackling Flame. When theſe are almoſt conſumed, lay on ſome more bundles upon the hot Aſhes, and proceed in this manner, 'till all the Matter you deſign for burning is by the Flames converted into Aſhes that are equally white, which will ſoon happen, if you keep them conſtantly ſtirring with an iron Rod. Theſe Aſhes, when they are ſifted, are what are ſold about by thoſe Perſons, who cultivate phyſical Plants for the Apothecaries. In the burning of theſe, now, we muſt particularly conſider all the *Phænomena*, tho' ever ſo common. In the firſt place, then, theſe Plants, when they are firſt laid on the Fire, emit a Smoke; and this Smoke grows gradually thicker and blacker, till it comes to be exceeding thick, and black, and is put into a very great motion, and then there immediately breaks out a Flame, in which there burns only a very lucid Fire, without the leaſt appearance of any thing black or ſmoky. In the ſecond place, the ſurface of the Flame, as well the top as the ſides, ſends forth a black Smoke, and is ſurrounded by it, as you may obſerve evidently by holding a piece of white Paper, or a clean Cloth over it. In the third place, it is obſervable, that the Smoke, when it is prodigious black and thick, and is whirled about with a very great rapidity, comes ſo very near to the Flame that preſently burſts out, that there is ſcarcely any difference between them: Nay, if by any accident the Flame is put out, whilſt there remain any black Coals in the combuſtible matter, there immediately ſucceeds a thick Smoke, which may be again converted into Flame, and ſo on for a great number of times. In the fourth place, ſo long as there is a good deal of black left in the burnt Plant, a Flame may be excited, particularly by the action of Wind, and there will be always ſo much leſs Smoke and Flame, as there is leſs black; nor will there ever ariſe a ſtrong Flame, 'till there appears a blackneſs in the combuſtible Matter. In the fifth place, when the black begins to be conſiderably conſum'd, there cannot be excited a Flame any longer, but there will then appear little fiery Sparks in every place, where there is the leaſt blackneſs left; but then there will be no viſible Smoke. Do therefore the Smoke, Flame, Sparks, Oil of combuſtible Bodies, and black coaly Subſtance, differ but very little, with regard to their Matter? Certainly, when the black is totally conſum'd, neither Smoke, Flame, nor Sparks appear any longer. Perhaps, therefore, the quantity of Fire only, and of courſe the rapider rotation of the Oil makes the difference. The Salt now prepared from theſe Aſhes, is more acrid, alcalious, and cauſtic than the former, and hence it corrodes more, reſiſts an Acid more powerfully, and excites putrefaction.

USE.

HERE then we ſee particularly the difference there is in Salts produc'd by Fire, according to the various manner of applying it; and at the ſame time we have here new inſtruments both in Phyſic and Chemiſtry, more alcalious indeed than the former, but yet not quite ſo. From what has been laid before you too, you evidently obſerve, that the Salts produc'd by this laſt Method, will differ much the leaſt from one another, and conſequently may be prepared from any dry Herbs mixed together that are fit for the purpoſe; for theſe Salts, when they are blended together, can't poſſibly be diſtinguiſhed from that procur'd from any ſingle Plant whatever: The commoneſt, therefore, are equal to the moſt valuable for this Operation.

PROCESS XII.

An acrid, alcaline, fix'd, igneous, vegetable Salt, and a Liquor from it, called Oil per Deliquium.

APPARATUS.

LET a full grown, freſh, ſucculent, green Plant be burnt to Aſhes in ſuch a manner, as to produce the *Sal Tachenianus*, according to the ninth Proceſs; for theſe Aſhes, in proportion to their quantity, will afterwards produce more Alcali than others: And to chuſe, let this Operation be perform'd in the Spring ſeaſon.

2. Or, as this greater quantity of Alcali, will not make amends for the extraordinary trouble and charge, let it be burnt only according to the eleventh Proceſs.

3. Let theſe Aſhes be put into a large earthen Veſſel, and be expoſed to a ſtrong Fire, ſo as to be perfectly red hot, taking care at the ſame time that they don't melt, for then they would run into Glaſs, and yield no Salt: But if this don't happen, the longer they are burnt in this manner, the ſtronger will be the Alcali that they yield afterwards. By this long continuance in the Fire, however, the acrid Alcali that is produc'd, is the more diſpoſed to diſſolve its ſocial Earth, to unite ſtrongly with it, and run into Glaſs, and thus inſtantly to deſtroy all the Alcali: For the Fire is capable of converting the fix'd part of Vegetables, when it is melted, into a fix'd, pellucid, and perfectly inſipid Gem, which then becomes greatly immutable, and appears exceeding ſimple. And hence the moſt antient Commentators upon the Sacred Writings have told us, that the whole World, when it ſhall be deſtroy'd by Fire at the general Conflagration, will be turn'd into Glaſs. And, indeed, in this Operation, if you protract it too long, or raiſe your Fire to too great a degree, there is often ſome true Glaſs found at the bottom of the Veſſel.

4. Let the Aſhes calcin'd in this manner, be boiled in an iron Pot, with four times as much Rain-water; and then let them ſtand quiet for half an hour,

that the *Fæces* may ſubſide to the bottom, and the *Lixivium* be clear at top. Take this *Lixivium*, and filter it through a thick Cloth, till it at laſt becomes exceeding limpid. Boil the *Fæces* up again with freſh Water, and keep them continually ſtirring with an iron Rod, and when you have procur'd a clear *Lixivium* as before, mix this with the former. The *Fæces* being flung away, put theſe *Lixiviums* into a clean iron Pot poliſhed within, and boil them till they are inſpiſſated almoſt to the thickneſs of Honey; and then you muſt keep them continually ſtirring with an iron Ladle, and that ſtrongly too, that they may not, as they begin to grow dry, ſtick to the Veſſel, for if they once do, there's no getting them off again. When they are juſt become dry, the Water being almoſt all expelled by the violence of the Heat, and the Maſs, on account of the ſeparation of the Water, now growing hotter, it on a ſudden rarefies and puffs up, and if you don't take care to keep it conſtantly ſtirring, the Matter will boil up and run over the Pot, and thus you will loſe a great part of your Profit and Labour. This agitation, therefore, muſt be continued till the Salt in the Pot grows perfectly dry, and then it will be white, alcalious, and ſufficiently pure. The ultimate dryneſs of it, however, is difficult to procure, and more difficult ſtill to preſerve.

5. Let the Salt thus prepared, whilſt it remains very dry and hot, be put into a ſtrong Crucible, and be melted in an intenſe Fire, and for an hour or two let it be kept in that condition. At the ſame time take care to have by you a clean, dry, metal Mortar, made very hot, into which cautiouſly pour the melted Salt out of the Crucible, be ſure taking care to hold your Tongs very faſt. As ſoon as ever the Salt is in the Mortar, let it be briſkly rubbed about with a hot Peſtil, before it hardens, and thus it may be reduced to a very dry Powder, which cannot be effected in any other manner, as it will grow moiſt from the Water in the Air. Whilſt the Powder then continues ſolid, and is exceeding hot, let it be put into a very dry, hot Bottle, made of green *German* Glaſs, with a pretty large Neck, and wide Mouth, ſtop this as ſoon as poſſible with a dry new Cork, drive it in very tight, and then dip the Cork and Mouth of the Bottle into melted Pitch: And thus you will have a pure alcaline Salt.

6. The longer this Salt is kept melted in the Fire, and the intenſer the Heat is, the more acid and igneous you will find it. And then too it will change from one Colour to another; for in the beginning it is greyiſh, then white, then ſucceſſively bluiſh, blue, greeniſh, and brown, and at laſt reddiſh like Marble. And the ſucceſſion of theſe Colours produced only by the ſtrength of the Fire, expreſſes conſtantly a greater degree of Acrimony, and more perfect alcaline diſpoſition. And here there ſeems always to remain ſo much leſs Oil united with this Salt, as it has for a longer time been expoſed to a greater degree of Heat. If any Perſon now has a mind to obſerve nicely all the different ſtates of this Salt, he may divide this Proceſs into as many parts as there are variety of Colours, and degrees of Acrimony juſt mentioned: Let the Operator, however, be very careful, that he is not deceived by any Colour that may ariſe from the falling in of a Coal, attending only to that which is produced by the intenſe action of the Fire.

7. In the ſame manner, the Juices of Plants, their Extracts, and native Salts, the tartareous Salts produced from fermented Liquids, and *Tachenian* Salts, yield ſuch an alcaline Salt as has been deſcribed, if they are expoſed to the ſame Fire.

8. In the mean time, however, there is obſerved a conſiderable diverſity in the production of theſe Salts; for ſome Vegetables afford a larger quantity of an alcaline Salt that becomes immediately very acrid, than others. Vine branches cut off in the beginning of the month of *March*, and burnt with an open Fire, yield abundantly an exceeding acrid alcaline Salt; and this Alcali, *Baſil Valentine* ſeems, in the preparation of his Antipodagric, and Lithontriptic Medicines, to have preferr'd to all others. The *Egyptian Kali* too, contains a great deal of a Salt that becomes alcalious, if it is expoſed to the Fire in this manner. But there is nothing from which this Salt is ſooner and better prepared than from Tartar of Wine: This certainly *Paracelſus* and *Van Helmont* look'd upon as the chief of all Alcali's. The Glaſs-makers obſerve, now, that the Glaſs that is made from the alcaline Salt of Fern, is greeniſh, and not ſo tranſparent, as that which is made from the *Kali*, which is exceeding clear; and hence this only is eſteemed by the *Venetians* for making the fineſt ſort of Glaſs. Upon this head conſult *Neri*, and Dr. *Merit.* And by ſome nice Obſervations that were made at the *Tuſcan* Court, there was diſcovered likewiſe ſome difference in the Chryſtals produc'd from ſuch alcalious Salts; as there appear'd too a variety in the Colours ariſing from the mixture of different Alcali's with *Mercurius Sublimatus*, and *Vitriolum Martis* diſſolved in Water. See *Tach. Hipp. Ch.* C. VII. and XVI. *Borrich. contra. Conring.* from p. 350, to 361. Hence, therefore, it appears, that there is in reality ſome difference in this Salt, ariſing from its natural origin, tho' but an inconſiderable one, in compariſon of that which proceeds from the various methods of making it.

9. In the Salt now prepared in the manner deſcribed, are obſerved the following Qualities:

1. The Taſte of it, if one may be allow'd to expreſs one's ſelf ſo, is igneous; for if a particle of it is laid upon a moiſt, ſound Tongue, it impreſſes ſuch a ſenſation on it, as would ariſe from a ſmall Live-coal, and there is immediately produc'd an Inflammation, and an Eſchar, which leaves behind it a ſlight Ulcer. But when by diluting it in Water, you have weaken'd it ſo, that it may be held in the Mouth without any inconvenience, you then have a Taſte like that of putrefied Urine; and hence theſe came to be called urinous Salts: But this Taſte is not properly in the Salt itſelf, but ariſes only from the Acid of the *Saliva*'s being abſorb'd by the Alcali, by which means its other part becomes volatile and occaſions it.
2. This Salt, ſo long as it remains pure and unmix'd, ſends forth no Smell that the Olfactory Nerves are capable of perceiving; but if it is mixed with any ſaline Subſtance, that is of the nature of the Native Salts of Animals, or *Sal-Ammoniac*, then the Acid of theſe being attracted into the Alcali, the other part is freed from this Acid which fix'd it before, and by this means becomes volatile, and diſcovers itſelf by a urinous, fetid, and, as it were, putrid Smell. And for this reaſon, again, the Artiſts, deceived by this ſudden alteration, called this a urinous Salt, attributing this Smell to the fix'd Alcali, becauſe this is not perceived in either of the Salts before the mixture, but upon the application of the Alcali to our Humours, they immediately acquire it.
3. The Colour of this Salt is various, white moſt frequently, or bluiſh. See No. 6.

4. If you take it in your Fingers, it ſeems to be oily, and when it melts in the Air, it produces a pinguious Liquor, which the Chemiſts therefore, have called an Oil.

5. If it is applied to the moiſt Skin of a Perſon in Health, and is covered in ſuch a manner that it ſhan't fall off, but ſhall remain fixed to one place, it will then ſoon be diſſolved by the natural Moiſture of the Body that is continually tranſuding, and being agitated by the vital Heat will cauſe an Itching, Heat, Redneſs, Pain as from Fire, a ſhining Tenſion of the Skin, a true inflammation, and a gangrenous, hard, black Eſchar, which will penetrate into the moſt internal parts of the Body, ſo that it acts upon the ſolid Parts in the ſame manner as Fire does. And as this changes the colour of the Bones, and turns them white; ſo theſe, if they are boiled according to Art in an alcalious *Lixivium*, grow white, likewiſe. And again, as Fire makes the Parts of Animals putrify in a ſhort time; ſo this Salt, if it is ſprinkled upon them and mixed with them, ſoon excites a fetid putrefaction. And hence, in this reſpect, this Salt, when it is pure, like poiſon, deſtroys the whole animal Machine, and that without remedy; for which reaſon it is a Salt dangerous to the human Body, and therefore not ſo prudently cried up among the modern Phyſicians for a very ſafe Medicine.

6. If this Salt is mixed with an Acid diſſolved in Water, it for the moſt part immediately produces an ebullition, hizzing noiſe, and inteſtine motion, and at the ſame time generates and diffuſes a large quantity of elaſtic Air; but being combined with the Acid in a certain proportion, it then becomes quiet, nor, though you add more afterwards, will it cauſe any farther effervеſcence. And this is always obſerved to be the caſe ſooner or later; for tho' the moſt acrid Salt of Tartar does not immediately cauſe an ebullition upon the affuſion of a ſmall Vinegar, yet it does in a ſhort time after.

7. Such an Alcali mixed and agitated with our Humours, and acted upon by our natural Heat, will be united pretty intimately with them all, will reſolve them, and attracting their Acid into itſelf, will change their ſaline part from a neutral ammoniacal diſpoſition to an alcaline one, from a ſoft to an acrid one, from a ſemi-fixed to a very volatile one, from a ſaponaceous to a leſs oily one, and from an inodorous to a fetid putrid one. If it is boil'd with Milk, however, that will be coagulated by it, whilſt the other Fluids of the human Body are rather reſolved by it. When therefore, by the action of Circulation, it is carried with our Humours into the minute Veſſels of the Body, it then corrodes them by its Acrimony. And as the Lungs firſt receive it into their capillary Arteries, after it is taken into the Body, and diſcharged by the Veins into the Heart; hence theſe are particularly affected by it. The gummy, reſinous, gummy-reſinous, oily, and viſcid parts of Animals and Vegetables, it diſſolves pretty well likewiſe; nay, and it opens, attenuates, and reſolves too the Oils of Foſſils, Sulphurs, and the tenacious Subſtances produced from them.

8. By Coction, or a long-continued Digeſtion with any ſorts of Oils in a proper degree of Heat, it becomes intimately united with them, and being managed according to Art, is converted with them into a true Soap, miſcible with Water, and detergent: And as by this means its own Acrimony

is diminiſhed, ſo it deſtroys likewiſe the tenacity of the Oil, and renders that diſſoluble in Water.

9. If this Salt is mix'd in a certain proportion with Sand or Powder of Flint-Stones, and is, kept in fuſion with them for a conſiderable time, it melts thoſe Bodies, unites them intimately with itſelf, and produces Glaſs, in which there is not then diſcoverable the leaſt indication of Salt. A ſurprizing *Metamorphoſis*, which was it not ſo evidently confirmed, one could never believe to be poſſible! This Glaſs, however, if it is melted with three times its weight of the ſtrongeſt Alcali, and diſſolved in it, may by this means be diluted with Water, and then if you drop a ſtrong Acid into it, the Alcali will be abſorbed, and a Powder of Flints will be precipitated to the bottom, as was formerly obſerved by *Van Helmont*. The Production of this Glaſs, *Tachenius* was of Opinion, was owing to a latent Acid in the Flints; but perhaps this ſpeculation was a little too ſubtle; for though we are certain, that this union does happen betwixt the Alcali and the *Calx* of theſe Stones, yet that this depends only upon the vegetable Alcali, and an Acid of the Flint, we think is a precarious Hypotheſis, not ſufficiently confirmed.

10. This Salt is a true Magnet to Water, and being impatient of dryneſs, attracts the Water out of the Air, ſwells, grows ſpongy, and ſoft, unites it to itſelf, diſſolves with it, and runs into an oily thick Liquor, that is ſomewhat tenacious, and is called an alcaline Oil *per deliquium*. If this is filtered through Paper, ſupported by Linnen, it becomes very pure, and among all Salts comes next in weight to Oil of Vitriol. If the Water is again drawn off from this by Fire, it returns pure Water. But the Acids likewiſe that float about in the Air are attracted into this Alcali along with the Water, and alter it according to their particular diſpoſition; and hence when this Salt has been moiſtned and dried in this manner a good many times, it becomes intirely changed from its former Nature, and approaches to that of the Salt which produced the Acid. Thus if the Acid of burning Sulphur predominates in the Air to which this Alcali is expoſed, it will acquire the Diſpoſition of a vitriolated Tartar: If Spirit of Nitre abounds there, it will come near to the Nature of Nitre: If the acid Spirit of Sea-Salt, it will produce Sea-Salt: If the Vapour of Vinegar, a regenerated Tartar; and if Oils very minutely divided, it will form a Salt, that is ſomething of the nature of a Soap. So long, however, as this Salt remains of a pure alcaline nature, it will retain its Water very tenaciouſly, and will not ſuffer itſelf to be dried, without a great deal of difficulty.

11. It will remain fixed a good while in the Fire tho' kept in fuſion, if it is contained in a Veſſel that it won't run through. If you keep it however melted by itſelf for a long time, it will at laſt exhale; but more particularly if you mix it with three times its weight of calcined Bones, or Earth that won't vitrify, and then expoſe it to an intenſe Fire; for then, as it won't eaſily melt on account of the Earth, nor will run into Glaſs, it will become volatile, as the Great *Boyle* obſerv'd long ago.

12. When it is perfectly ſaturated with a pure Acid, ſo that it won't take in any more, and by this means neither the Alcali nor Acid, in the leaſt, predominate,

dominate, then by Dilution, Filtration, Inſpiſſation, and Chryſtallization, it will produce a true compound Salt, of the Nature of that which yielded the Acid. Hence theſe compound Salts have been ſuppoſed to be actually generated in this manner; and for this reaſon the Alcali has been looked upon as the Mother that receives the ſeminal Acid; as of itſelf, empty, and barren; and as a Chaos, and the univerſal *Matrix* of all Salts: And hence the Alcali has been called the Female, the Acid the Male.

13. By attracting Acids into itſelf, it ſeparates them from other Bodies, and by this means brings about in Nature an infinite number of ſingular effects. Hence, for inſtance, it comes to paſs, that by the admixture of an Alcali, Native Vegetable Vinegar, the ſame prepared by Art, and Spirit of Alum, Nitre, Salt, Sulphur, and Vitriol, are converted into Water, all their Acid being by this means abſorb'd. And the Salt thus generated is a fixed one, except only that that from the Vinegar is volatile, the Alcali itſelf being by this Union rendered ſo.

14. If it is fuſed with a proper Fire, it becomes capable of penetrating thro' earthen Veſſels, and even metalline ones too, tranſuding through the former, and corroding thoſe made of Braſs, or Iron. Nay, I found, that Iron was eat away with it, when I only covered the crucible in which it was kept melted, with an Iron Plate; for by this means it became brittle: Braſs it conſumes in a ſhorter time.

15. It precipitates Metals that are diſſolved in Acids. If it is dropped into a ſolution of Mercury corroded by an Acid, called ſublimate, it precipitates the Mercury to the bottom of the Water, and the red colour of the ſubſiding Powder is ſo much brighter as the Alcali is ſtronger and purer: Hence therefore we have a pretty certain Method of trying the purity of an Alcali.

16. The Juices of the Turnſole, Roſes, and Violets, it changes green, which grow red with an Acid.

17. This Salt never naturally appears as ſuch, either in the Animal, Vegetable, or Foſſil Kingdom, being produced only from Vegetables by the aſſiſtance of an intenſe Fire. It is a proper Creature of the Fire therefore generated from Vegetables burnt to Aſhes: And thus it is generated always. With theſe Aſhes it ſinks down into the Earth; and yet it never appears there afterwards. There, therefore, it muſt loſe its alcaline, and put on ſome other Nature, and thus produce a new Body, which by a natural revolution may, in time, come to be converted into an Alcali again.

18. If this Salt runs *per Deliquium* in the Air, is then dried, and melted in the Fire, and afterwards expoſed again to a moiſt Air, and dried, and ſo on, and theſe Operations are ſufficiently repeated, it will at laſt be reſolved into a volatile part, and earthy *Fæces*. The Nature of a fixed Alcali, now, you formerly underſtood from the moſt undoubted Experiments, when I deſcribed it theoretically in our Doctrine of *Menſtruums*, Vol. I. p. 440, *& ſeq.* If you will but compare therefore what you find there with what we have now delivered here, you will be able to form a true judgment of alcaline Salts, which have been ſo famous both among the Chemiſts and Phyſicians, for the two laſt Centuries; and upon examination you will be ſurprized to find how little thoſe Perſons truly knew of them who have

written ſo largely about them in both theſe Arts. If you have a mind, therefore, to have a true and particular account of the vertues of Alcali's in the human Bodies, conſult what has been ſaid before: Or if you had rather have a brief recapitulation of them, take it as follows. 1. They in a ſhort time deſtroy all the Acid in the Human Body; for there is but a little there, and that a pretty mild vegetable one, and only in the firſt paſſages. 2. If they meet with an Acid there, they cauſe an Efferveſcence, generate Air-Bubbles, Wind, and *Flatus's*, ſtimulate by their activity, and are converted together into a neutral Salt, which is then harmleſs, penetrating, aperient, diaphoretic, diuretic, and antiſeptic, and produces new effects, depending upon the new Salt thus generated, and conſequently not ſo properly to be aſcribed to the Alcali's, tho' they appear indeed after the taking them. 3. By means of the effervescence thus excited they ſtimulate the Nerves, put the animal Spirits in agitation, and alter the motions that the Nerves and Spirits were in before: Hence they often remove Hypochondriacal, and Hyſterical Spaſms; and cure Diſtempers depending upon them, as we ſee in the famous Anti-emetic of *Riverius*, *viz.* an Alcali mixed with Juice of Lemons, which being drank in the very act of Effervescence, cures *Cholera's*, and moſt ſtubborn Vomitings, not to be ſubdued by any other method. 4. This Salt diſſolves any ſubſtances coagulated by an Acid; and hence where Milk curdles upon the Stomach, if it is prudently given, it has a very good effect: Other tenacious Bodies too it reſolves, and pretty ſucceſsfuly. 5. It attenuates glutinous, oily, and pinguious ſubſtances, and renders them more eaſily miſcible with Water, on which depends the cleaning of Bodies, and hence the Fullers, Scourers, and Dyers find that the ſcouring them from any pinguious viſcid matter is particularly effected by a Lye of theſe Salts. If they are moderately uſed, therefore, they will free the Chylopoietic Syſtem from any glutinous impurities. 6. They reſolve the *Coagulums* of the Bile, Lymph, Blood, and *Serum*, when they are admitted into the more internal parts of the Body, and are rendered active by the vital Powers. 7. By their acrid *Stimulus* they put in motion the Bodies that are inactive, and hence they promote Urine, Sweat, and Perſpiration, and for this reaſon are ranked amongſt the Diuretics, Diaphoretics, and Sudorifics: The Inteſtines too they empty by Stool. 8. In Diſeaſes, therefore, where an inert, viſcid, mucous *Pituita* prevails, and hence an acidity of our vegetable Food in the firſt Paſſages, where there appears an auſtere aceſcent Matter, or its effects, manifeſt by coagulation, where an aqueous *Serum* abounds, or a tenacious, pinguious Matter predominates, or where we find Diſtempers which have been produced by theſe cauſes, as the Dropſy, Jaundice, *Leucophlegmatia*, Gout, Rheumatiſm and Scurvy; there this Salt is of excellent ſervice, if it is given, well diluted, in a ſmall quantity, and is continued in the uſe of a ſufficient length of time. That kind of Gout at leaſt which owes its origin to an Acid will ſcarcely perhaps be cured more ſucceſsfully by any method, than by ſmall doſes of this Salt ſufficiently repeated. We muſt take care however, not to cry it up immediately as an univerſal antipodagric; for it will certainly be prejudicial to thoſe Perſons who are troubled with hot, bilious Juices, and whoſe Humours ſpontaneouſly tend towards a putrid alcalious Diſpoſition. 9. To the Surgeons likewiſe theſe Salts prove of excellent Service: By their cauſtic power they raiſe an Eſchar when you want an Iſſue; with a *Lixivium* of them are ſucceſsfully clean'd, putrid foul Ulcers; if Parts that are gangrenous are ſcarified almoſt to the quick, and then fomented with a *Lixivium* of them, they contract into a Cruſt, and ſuffer a ſeparation from the living part, by which means the mortification is prevented from ſpreading any further, and a happy cure is effected; they extirpate Warts too, and ſafely enough eat away ſmall Cancers; and if they are ſufficiently diluted, will take away Spots in the Skin very efficaciouſly. 10. We muſt add, however, in the laſt place, that the uſe of theſe Salts is very pernicious in every Diſeaſe where the native animal Salts begin to degenerate towards an acrid, alcaleſcent, putrid, volatile nature; or where the natural Oils are tending to an acrid, fetid, putrid, rancid, and volatile Diſpoſition, diſcovering itſelf by a diſagreeable Smell, and the red colour of the Urine. But theſe Salts become particularly deſtructive, where the Bile is degenerated in this manner, and where the Humours of the Patient are too much diſſolved, fluid and putrid; for which reaſon in the Plague they are almoſt a preſent Poiſon, their pernicious Quality evidently remaining even in the Soaps that are made with them. Hence, therefore, in Inflammations, Suppurations, Gangrenes, *Sphacelus's*, continued putrid Fevers, and Diſeaſes that ariſe from too ſwift a circulation, the internal uſe of theſe Salts ought to be abſolutely avoided. 11. And, indeed, where it does appear proper to uſe them, let it be done with caution. Let a Drachm of 'em be diluted in twenty times its weight of Water, and let ſcarcely ever more than this quantity be given at a time: Let the Phyſician too in the repetition of them carefully attend to all the Symptoms that occur, that they may be left off as ſoon as ever their aſſiſtance is no longer neceſſary; and by this means he may uſe them ſucceſsfully without any fear of danger. And laſtly, let him take care to determine them to ſuch parts of the Body, and make 'em produce ſuch particular effects as the circumſtances of the Patient require, as we mentioned before in the uſe of the *Sal Tachenianus.*

PROCESS XIII.

A very acrid, alcaline, igneous Salt made with Quick-Lime.

APPARATUS.

TAKE Lime made of burnt Stones, that is quite freſh, very dry, ſolid, not affected by any moiſture, nor as yet cleft aſunder; of this, put 1 part into a clean iron Pot, and lay upon it 2 parts of the pureſt Pot-aſhes, in ſuch manner that the Lime may be covered all over with this Alcali. Let theſe be then left together in the Pot, with a Cloth flung over them, till the Lime begins to crack and ſplit aſunder. When you obſerve this, add 4 times their weight of Water, and boil them for the ſpace of one or two hours. When the *Fæces* are ſubſided, pour off the Liquor, and let it be ſtrained through *Hippocrates*'s Sleeve made of thick Linnen Cloth, till it at laſt paſſes through as limpid as pure Water. Put this *Lixivium* into a large iron Ladle over the Fire, and taking care that it don't boil over, evaporate it till it becomes perfectly dry. Then increaſe your Fire till the Ladle grows red hot, and as ſoon as ever the Salt has done ſmoking, it will melt. When it is in this ſtate, pour it out upon a hot braſs Plate, and whilſt the Matter continues very ſoft, make it ſmooth, and cut it into ſuch pieces as are fit for chirurgical uſes. Let theſe be immediately put into a very dry, hot, ſtrong, glaſs Bottle, by the Fire ſide, and inſtantly ſtop it with a choice dry Cork: Let the Mouth of the Bottle be then dipp'd into melted Pitch, and be very accurately ſecured, that no Moiſture may poſſibly get through it, which is attracted by the Alcali prepared in this manner with an incredible power, nay, even through Corks and Bladders: But if you obſerve theſe cautions, it may be kept pure for years. When you want to take a bit out for uſe, it muſt be done in a dry hot Air, or near a good Fire, and then the Bottle muſt be immediately ſtopt again as before.

USE.

1. THIS Salt, from the truly igneous vertue of the Lime attracted into the fixed igneous Alcali, acquires a moſt acute and quick corroding Power, which was neither in the Alcali nor the Lime when they were ſeparate. The Acrimony of it exceeds that of all other Salts hitherto known: For if you cut a round hole in a ſticking Plaiſter, and apply this to the human Body, and then put a bit of this Salt upon the Skin in the vacuity, and cover it over with another Plaiſter that it ſhan't fall off, it will in a very ſhort time conſume the Skin, and the *Membrana adipoſa*, and hence is valued by the Surgeons, for what they call their Potential Cautery, above all others.

2. If almoſt any parts of Animals are thrown into a freſh *Lixivium* of this Salt whilſt it is boiling, they will in a ſhort time be converted into a liquid Matter, as will likewiſe moſt vegetable Subſtances, and the ſulphurs of Foſſils. A poor Man unfortunately falling into a boiling Copper of ſuch a *Lixivium*, had his Clothes, and all the ſoft parts of his Body conſumed, ſo that there was found nothing of him left but his Bones. Hence this *Lixivium* is of incomparable ſervice, where the parts are gangrenous to a great depth, and almoſt ſphacelated, as it diſpoſes them to a happy ſeparation; but it requires the prudent application of a ſkilful Surgeon.

3. This Salt melts with a pretty moderate Fire, and then it runs like Wax. By this eaſy fuſion, therefore, it is capable, without the aſſiſtance of an intenſe Fire, of diſſolving a great many Bodies, that otherwiſe are not diſſolved without difficulty, as Gum Myrrh, Sandarach, and others. The ancient Chemiſts wrote a great deal about the Art of making Alcali's melt in the Fire like (*Cera*) Wax, and hence they called the Operation *Inceration*. Might they not poſſibly mean the Proceſs we have juſt deſcribed? Certainly the Salt produced by it has this property.

4. If Lime is firſt ſlack'd, or extinguiſhed either in the Air, or with Water, as almoſt all old Lime is, or is converted into a fine Powder, then if it is thus managed with a fixed Alcali, it will not produce this acrid kind of Salt:

Nay, and this Salt, when it is once melted in the Air, or is kept by a good while not carefully ſtopt, loſes this ſingular Vertue; and then it depoſites a large quantity of inactive, ſtoney *Fæces*, which did not appear before. Hence, therefore, we learn, that Fire communicates to inert Stone, and Shells of Fiſh, an Acrimony that is not eaſily procurable in any other manner. When a native, vegetable Salt, therefore, from a neutral, ſoft, ſaponaceous one, is converted into a fixed Alcali, does it not acquire this Acrimony from the Fire?

5. The Salt thus prepared obtains this ſingular property, that it becomes vaſtly diſpoſed to a union with the expreſs'd and diſtill'd Oils both of Vegetables, and Animals, and thus to form a Soap. And this ſeems to ariſe from its being rendered ſo exceeding penetrating, that it becomes capable of intimately dividing theſe Oils, and uniting with them, which without the Aſſiſtance of this ſharp Lime can ſcarcely be effected conveniently. Nor without the Lime would the Alcali run ſo eaſily in the Fire; for that melts with a great deal of difficulty.

6. And here terminates the Power of the Chemical Art upon fixed alcaline Salts, which cannot, as far as I am acquainted with them, be carried to any greater perfection. Let us therefore to theſe Demonſtrations ſubjoin a few Corollaries.

COROLLARIES.

1. FIXED vegetable Salts are produced only by Fire, from Vegetables that are fit for this purpoſe. Some Plants, when they are burnt, ſcarcely yield any of this Salt: And even thoſe that are naturally diſpoſed to do it, if they are expoſed a great while to the Air, and are alternately dried, and moiſtened for a conſiderable number of times, loſe at laſt all that Matter, which in burning wou'd have produced an alcaline Salt, and therefore, if they are then burnt they yield none at all: For the Air, whilſt it affects Vegetables by its warmth and moiſture, acts upon the Matter of the ſecond Proceſs, and carries it up into the Atmoſphere, and thus evidently makes it appear, that that part, which the Fire thus fixes into an alcaline Salt, was ſpontaneouſly volatile.

2. Fixed alcaline vegetable Salts are generated only by Fire, whilſt it actually conſumes Plants, that are diſpoſed for this Operation: For in the matter of the ſecond Proceſs there is never diſcovered any ſuch Salt; nor does ever any appear in the ſeventh: But it is ſolely and purely the effect of a burning Fire. And here we obſerve, that according to the degree of it, and the different length of time it is applied, the Salt becomes ſtronger, more fixed, and more alcalious. I confeſs, indeed, that in Muſtard Seed there naturally exiſts ſomewhat alcaline, as appears by its effervescence with Acids; but this is volatile, and vaniſhes when the Muſtard Seed comes to be burnt. In order, now, to a demonſtration of theſe two Corollaries, it was neceſſary to go through, in order, all the preceding Proceſſes; and thus at length it evidently appears, that this fixed Alcali is a creature of the Fire.

3. A fixed alcaline Salt, therefore, is not a native, vegetable Salt. A native Salt, I call that which by the particular nature of any Plant is generated from the common nutricious Juices of the Earth, and which of conſequence will always

remain in it ſo long, as it is left to itſelf, and has no violence offer'd to its natural Diſpoſition: But this is deſtroyed by the Fire, and is converted into ſomething of a quite different Nature. Does not the larger Garden Sorrel abound with a native acid Salt? This the ſeventh Proceſs ſufficiently evinced; and yet if you burn even this in an open flaming Fire, you will have a fixed Alcali from it, though before it evidently contained an Acid. This Alcali, therefore, is not native to Plants, but is changed by the Fire from a Non-alcali to an Alcali.

4. Hence we underſtand then what an alcaleſcent Vegetable properly is: For by this name are meant, firſt, ſuch as contain a Juice that abounds with an Acrid, and almoſt alcalious *Halitus* or Vapour, but which, at the ſame time, is always volatile; as we ſee in Garlick, Onions, and others: Secondly, thoſe that by their acrimonious *Stimulus*, increaſe the circulation of our Humours through their Veſſels, and by this means cauſe our native Salts to degenerate towards an alcaline diſpoſition: Hence the warmeſt aromatics, though they are not alcalious in themſelves, yet occaſion the Salts in the human Body to incline that way: And, thirdly, thoſe from which the Fire will produce a great quantity of a fixed alcaline Salt.

5. Betwixt the native vegetable Salt, therefore, of the ſeventh Proceſs, and the moſt acrid, alcaline, fixed one of the twelfth, there are a great number of *Species* of fixed Salts, all which, as they differ in their phyſical action, and conſequently in their internal nature, ought to be properly diſtinguiſhed from one another. Let us take, for inſtance, the beſt *Rheniſh* Tartar: This is the native Salt of the Wine, perfectly acid, and in ſome meaſure ſharp; and hence in alcaleſcent, bilious, putrid Diſtempers it is of excellent ſervice. If this is diſtilled in a glaſs Retort, with a gentle Fire, it yields a ſmall quantity of an aqueous, acidiſh, light Liquor, which aſſwages thirſt. When this is drawn off, the Body that remains in the Retort begins already to be alcaleſcent, and if a Perſon takes a proper quantity of it, it will make him hot and droughthy. If you then urge the remainder with a Fire a ſmall matter ſtronger, there will ariſe a fragrant, penetrating, bitter, heating Oil, of a golden colour; and this being ſeparated, the remaining Maſs will appear black, will be more alcalious than it was before, will heat the Body more, create a greater Thirſt, and being boiled with Spirit of Wine, will yield a noble, aperient, detergent, diuretic, anti-hydropical Medicine. If you ſtill go on to increaſe your Fire, you will have a thicker, tenacious, fetid, bitter Oil, and at the bottom of the Retort there will be left a very black Coal, which will be much more alcalious than the former: And if this is then taken out and put into a Crucible, and expoſed to the moſt intenſe Fire it will at laſt produce a fix'd alcaline Salt, which, according to the ſtrength and duration of the applied Heat, will be continually changed in all its properties, becoming conſtantly more and more acrid, as the action of the Fire upon it is longer continued, and more intenſe. Here, therefore, we ſee a Salt in its native ſtate, truly acid, but after it has paſſed through various changes at laſt extremely alcalious.

6. There ſeems now to be three cauſes, in particular, that produce a difference in theſe Alcali's: For, in the firſt place, this appears to depend upon the quantity of the combuſtible Oil, that ſtill adheres to the ſaline Matter; for the greater this is, the leſs acrid will the Alcali be in proportion; and the contrary.

But in the ſecond place, this ariſes likewiſe from the artificial combination of this Oil with the Alcali; for if the Plant is only uſtulated with a ſlow ſmothering Fire, according to the ninth Proceſs, it will yield a greater quantity of Salt, but leſs acrid, and alcalious; but if it is once expoſed to a ſtrong open Fire, it will produce leſs, but the Acrimony will be greater. And in the third place, the proper action of the Fire itſelf ſeems to add ſomething of an igneous quality to the Alcali, whether this ariſes from the fixation and accretion of the very ſubſtance of the Fire itſelf to the Salt, or only from a power it poſſeſſes of altering it in this manner; as I juſt now explained in this Proceſs. This certainly is indiſputably certain, that the longer Lime is burnt, and the intenſer the Fire is that is made uſe of in the Operation, the more Heat, or which is the ſame thing, the more true Fire it will excite in cold Water. Nay, and even fixed Alcali's themſelves will generate more Heat in cold Water, as they have been expoſed to a greater Torture of the Fire. But in the fourth place too, perhaps we may here add the original ſeminal property of Plants, which is not very eaſily deſtroyed. One Plant ſhall yield a great deal of fixed Salt; another, nothing at all; not that this laſt naturally contained leſs Salt than the former, but becauſe it was of ſuch a nature, that it wou'd not bear to be fixed, by the Oil, or Earth, or both together?

7. From what has been ſaid then we underſtand the origin of alcaline Salts in Animals, ſo far as they regard the matter of their Food, Drink, and the common Air they breath in. For Animals that live ſolely upon Vegetables and Water, take into their Bodies the very Matter, from which the alcalious Salts we have been deſcribing are produced; though no body indeed cou'd naturally ſuſpect, that ſuch an inſipid Body as ſoft, moiſt Graſs, ſhou'd, only by being burnt, yield an acrid, igneous Alcali: Or who can poſſibly diſcover any thing of this kind in Ale or Wine? and yet Experience abundantly demonſtrates, that an Alcali may be produced from them. The Action now of the Animal Body brings this latent matter to light, and makes it manifeſt. A Child that is fed with nothing but ſweet Milk, which does not diſcover the leaſt degree of ſaltneſs in it, makes conſtantly a ſalt, acrid Water, not by actually generating any Salt, but by ſetting that at liberty, which before lay concealed; and the Urine of a Bullock, living only upon Vegetables, is found to be exceeding ſalt, for the very ſame reaſon. How this Salt, however, comes to be volatile in Animals, will appear hereafter, when we come to treat of Animal Salts.

PROCESS XIV.

An acrid, fix'd, vegetable Alcali yields a bitter, chryſtalline, hard, fix'd Salt, that is ſubvitreſcent, and not alcalious.

APPARATUS.

OF the beſt Pot-aſhes I take 6 Pounds, and putting them into a clean glaſs Veſſel, pour upon them 20 Pints of cold Rain-water, and then ſtir them well about with a ſtick, and in this condition ſet them by. When the Parts that will not diſſolve have ſettled for a ſufficient time, I gently pour off the clear *Lixivium*, and together with the *Fæces*, there will be found at the bottom a great number of very ſmall Maſſes, of a grey Colour, and bitter Taſte, that have almoſt the hardneſs and brittleneſs of Glaſs, and in which one can diſcover nothing of an Alcali: And this is the manner of preparing this Salt. But I'll make the ſame here in a neater manner before you. I take then 6 pounds of the beſt Pot-aſhes, and diſſolve them in a braſs Kettle, by boiling them with four times their weight of Water. This *Lixivium*, whilſt it is boiling hot, I ſtrain through a linnen Bag that it may be nicely depurated whilſt it is in this degree of Heat, and in this condition; put it into a hot, damp, clean glaſs Veſſel, and ſo leave it. In a ſhort time then, an opakiſh Cruſt, of a browniſh grey Colour, begins to fix itſelf to the bottom and ſides of the Veſſel, which increaſes, and grows thicker continually: When the *Lixivium* has ſtood thus for ſome time, nor does depoſite any more of this Salt, I very gently pour off all the pure Liquor that ſwims at top, and at the bottom there remains a Salt, like that procured by the former method, but purer, and in a greater quantity, as you yourſelves are witneſſes. If I take now the *Lixivium* thus freed from this Salt, and inſpiſſate it a little, and ſet it by, it will yield perhaps a ſmall matter of the ſame kind of Salt, but it afterwards will produce no more, ſo that there is but a certain limited quantity of this Salt in the Alcali.

If the Salt ſeparated in this manner, is ſhook with cold Rain-water, it will not be diſſolved by it, but then the Alcali that adheres to it, will be thoroughly waſh'd away, ſo that by this means it will become perfectly pure; and if you then gently dry it, it will be ſimple, and may be preſerved ſo, under what title you pleaſe.

The NATURE and USE of this SALT.

1. SOME Perſons well ſkill'd in the Chemical Art, formerly aſſerted, that a proper fix'd alcaline Salt can ſcarcely be reduc'd to chryſtalline Glebes; and this aſſertion has a good deal of truth in it. When the more modern Chemiſts, therefore, have ſhewn the Salt thus ſeparated from an Alcali, as an alcaline Salt, they have not diſtinguiſh'd ſo carefully as they ought to have done; and indeed, when an Alcali is well freed from this Salt, it is difficult to form it into Chryſtals, tho' it is poſſible, however, to do it.

2. This Salt never ſpontaneouſly diſſolves in the Air. In cold Water it does not melt very eaſily. In hot Water, and a good quantity of it, it will at laſt be diſſolv'd, but as ſoon as ever the Water grows cold again, it hardens into little Glebes. It is hard, and brittle, and may be reduced to a fine kind of mealy Powder, which will continue dry. It has an exceeding bitter Taſte, which remains in the Mouth for a conſiderable time. In the Fire it crackles, and flies about pretty violently. It is neither acid, nor alcalious, nor indeed, like any other Salt that we are hitherto acquainted with, but a perfect new one. It ſeems, however, to come neareſt in nature to that Salt which is thrown up in making of Glaſs, and being collected at top, goes by the name of the Gall of Glaſs. Does the Fire now, whilſt it is producing the Alcali from Vegetables, generate this Salt with it likewiſe? And does the Fire, when it combines together the Alcali, and the *Calx* of Flints in the production of Glaſs, ſeparate again this Salt, and throw it upwards? Certainly this does not ſeem improbable.

And hence we may in ſome meaſure underſtand why no ſuch Salt is procured from the Alcali of Tartar; for Tartar is generated in exceeding fine Particles, from a ſubtil fermented Liquor. A farther application of this Salt to various Bodies in different degrees of Heat, will diſcover the other properties of it, which as yet lie concealed.

3. A fix'd Alcali, when it is perfectly freed from this Salt, differs intirely from the ſame when united with it. Whenever, therefore, I want to make any Experiments with a pure Alcali, I always take care firſt to ſeparate this from it; otherwiſe it often deſtroys the true alcaline vertue, or renders it leſs efficacious.

PROCESS XV.

A common diſtill'd Water from green Roſemary, per Veſicam.

APPARATUS.

1. Having in our five firſt Proceſſes ſeen what parts thoſe are which remain in Plants, after they have been expoſed to as great a degree of Heat as can be communicated to them by the mediation of Water, we muſt now examine what part that is which evaporates from the Plant whilſt the Water is boiling, and is diſſipated into the Air; for thus ſhall we proceed moſt methodically. And this will be beſt effected by cloſely fitting on an Alembic to a Still, which by this means will collect all the exhaling Vapour, condenſe it, and diſcharge it into the Receiver.

2. In the Proceſſes 32, 33, 34, 35, 36, 55, 86, it will hereafter appear, what volatile parts may be ſeparated from Vegetables by a degree of Heat, beginning from that of boiling Water, and increaſing to the greateſt almoſt that the Veſſels are able to bear without melting; but, now, if we wou'd avoid confuſion, we muſt collect all that which will exhale from a freſh Plant, with all the degrees of Heat, from the natural one in Summer, to that of boiling Water. And here, again, we muſt make uſe of the ſame Herb Roſemary, that, by this means, we may be able to compare the production of this Proceſs, with the different parts procured from it by the preceding.

3. Inſtead of Roſemary, however, you may ſubſtitute any of the Vegetables mentioned, as proper for the firſt Proceſs, which diſtinguiſh themſelves particularly by their Smell and Taſte, as will appear by examining thoſe few of which I have there given you a liſt: In which we ſee by the former Proceſſes, there is contained an oily inflammable Matter, and a ſaline one that will bear to be fixed; as alſo an oily ſaponaceous one ariſing from the combination of theſe two together.

4. The Plants, deſigned for this Operation, ſhould be gathered at that time of their growth, when they are juſt come to maturity, and the Plant is juſt diſpoſed to put forth its Flowers, and yield its Fruit, before either the Seeds or Flowers are perfect; for that vertue of Plants which we ſeek in their Water, is often found to be rendered effete, when they have produced their Fruit, a languidneſs, and diſpoſition to wither frequently ſucceeding. The Morning too is particularly proper for gathering theſe Plants, as the volatile Particles

collected by the cold of the Night, and entangled by the viſcidity of the Dew, are not then diſſipated by the Heat of the Sun. Theſe cautions, we mean, ſhould be obſerved when the vertue of the diſtilled Water reſides in the Leaves of the Plant, as in Mint, Marjoram, Penny-royal, Rue, and a great many others.

5. But the caſe is otherwiſe, when there is an aromatic vertue in the Flowers, and in no other part of the Vegetable, of which the Roſe, Lily, Lilies of the Valley, and many more are inſtances; for then we chuſe the flowering parts, when they diffuſe the moſt fragrant Scent. Let the Flowers, therefore, deſigned for this Proceſs, be gathered when they are almoſt full blown, but not at all withered, and in the Morning whilſt the Dew is ſtill upon them. Sometimes too the Seeds of Vegetables are preferable to all the other parts of them, as we ſee in the Caraway, Aniſe, and Cummin, and others, where the Flowers and Herb are inactive, whilſt the Seed contains a ſingular vertue diſcovering itſelf by its fragrant Scent, and warm pungent Taſte. Theſe Seeds, now, ſeem to poſſeſs this in its greateſt perfection, juſt when they are come to be thoroughly ripe, at which time, therefore, they ought to be gathered. Nor muſt we omit taking notice, that the moſt excellent qualities of ſome Vegetables reſide ſolely in the Root, witneſs the *Caryophyllata*, or Avens, and Orpine, whoſe Root has the Smell of a Roſe. Theſe Roots, therefore, when they are deſign'd for ſtilling, ſhou'd be dug up at that time of the year, when their vertue is greateſt, which is generally when they are juſt going to put out Leaves; and theſe too ſhould be taken up in the Morning. If the properties we want reſide particularly in the Bark, or the Wood, then of courſe we chuſe thoſe for our purpoſe.

6. With ſuch a Plant, either pounded or cut, as is moſt proper, fill a Still two thirds full, taking care not to ſqueeze it down hard. Pour upon it as much Rain-water, as, together with the Herb, will fill the Still to the ſame height, *viz.* two thirds. Let an Alembic or Head be then fixed cloſe on the Still, ſo that none of the Vapour ſhall be able to eſcape, which, as the Workmen contrive them, is done very eaſily; and let the Beak of the Alembic where it goes into the Worm be luted with Linſeed-flower work'd with Water into a very ſtiff Paſte, taking care at the ſame time, that the Worm is well clean'd, by pouring boiling Water through it, that it may not taint your diſtill'd Water. To the lower extremity of the Worm, then, apply a Receiver, and thus none of the Vapour exhaling during the boiling will be loſt, but being cool'd and condenſed in the Worm, which is fix'd in a Tub of cold Water, will be all collected in the Receiver, in form of a Liquor, eſpecially if you take care now and then to put ſome cold Water into the refrigeratory, which will grow otherwiſe hot in the diſtillation.

7. Every thing being thus prepared, digeſt with a gentle Heat of 150 degrees for the ſpace of four and twenty hours: Then increaſe your Fire till the Water and Herbs in the Still boil ſoftly. This may be known from a kind of hizzing noiſe one may hear from the burſting of the bubbles form'd by the boiling; from the end of the Beak of the Alembic, or the beginning of the Worm's being ſo hot that one can't bear ones Hand upon it; from the Water in the Refrigeratory's beginning to ſmoke with the Heat of the Worm; or laſtly, from the drops following one another ſo faſt into the Receiver, that

there is almoſt one continued little ſtream. By all theſe ſigns, then, you may know when you have got the degree of Heat you want, which, being leſs than what will make the Decoction boil gently, you will not be able to raiſe thoſe vertues you are in purſuit of. And on the other hand, if your Fire is too ſtrong, the boiling Matter will be forced up into the Alembic and its Beak, and thus will ſpoil the diſtill'd Water; and beſides the Herbs likewiſe being carried up with the Water, will paſs into the Cavity of the Worm, and ſtop it up, and ſpoil it. For this reaſon, therefore, I uſually faſten a piece of thin looſe Cloth upon the Mouth of the Alembic where it goes into the Worm, that if the Fire ſhould happen to be ſo ſtrong as to make the Herbs riſe thither, they may be prevented ſtopping up the Worm. But even then, there ſometimes follows a greater inconvenience, for the Herbs by this means being collected in the Beak of the Alembic, ſtop the paſſage of the Water and Vapour into the Worm, which being by the Fire rarified in the Alembic, ſometimes throws it off with a vaſt *impetus*, and pours out a ſcalding Steam, which if it is at once received into the Face, Eyes, or Lungs, may do a vaſt deal of damage, nay, may prove inſtantly fatal. Every Perſon, therefore, ought to be very cautious the firſt time he performs this Operation. And here let him obſerve, that the more oily, viſcid, gummy, and reſinous the Herb is, the more Spume of conſequence will be generated in the boiling, and hence the danger of this accident will be proportionably greater.

8. The degree of Heat then being by the ſigns abovementioned very carefully obſerv'd, it muſt be kept up ſo long as the Water that diſtills into the Receiver, is white, thick, odorous, ſapid, frothy, and turbid; for this muſt by all means be kept ſeparate from that which follows. For this reaſon, the Operator muſt often change his Receiver, that he may be ſure when this firſt Water ceaſes to come over. After this then is drawn off, you have another Water, which is pellucid and thin, and has not the proper Scent of the Plant, but generally ſmells a little acidiſh, nor the natural Taſte of the Plant, but is ſomewhat upon the acid, is ſcarce frothy, but limpid, except that is rendered in ſome meaſure impure, by little white kind of ſtrings and flakes that ſwim about in it: And if the whole inſide of the Copper Head is not well tinn'd, this laſt Water, by its acidity, will corrode the Copper, and by this means will be tainted by it, become greeniſh, and excite *nauſea's*, and vomiting, and thus proves a poiſon to thoſe Perſons that make uſe of it, particularly to the Infirm, and Children, whom it will work both upwards and downwards, with very painful gripings. If ſuch an accident, therefore, ſhould unfortunately happen, let the Patient drink very plentifully of Milk ſweeten'd with Honey, or ſome emollient Decoction.

9. The firſt of the Waters, which we juſt now deſcribed, contains in particular, the Oil of the Plant, and *Spiritus Rector*, and always at the ſame time ſomewhat ſaline, which in moſt is of an acidiſh nature, but in the acrid antiſcorbutic Plants, of a volatile alcaline one: For the Fire, whilſt it boils the Herbs, diſſolves, and attenuates their Oils, reduces them to their ſmalleſt particles, and with the aſſiſtance of the Water, carries them up together with all thoſe parts of the Plant which are diſpoſed to become volatile with this degree of Fire. And if your Veſſels have been kept accurately cloſe, then all theſe will be united together, and be diſcharged into the Receiver, without any diſſipation or loſs,

or much alteration. This certainly is the caſe, if we can at all truſt our Senſes; for the proper Smell, Taſte, and ſingular vertues of the volatile parts of Plants, are found to be abundantly contained in theſe diſtill'd Waters. If the Botaniſt, therefore, would give us a true account of the vertues of any Plants, ſo far as they reſide in that part of them that becomes volatile by boiling, then the Chemiſt wou'd be able to exhibit thoſe ſeparate from all the reſt. This *Tournefort* attempted in his Treatiſe *Of Plants growing about Paris*; *Ray*, in his, *Of the Native Plants of England*, and *Dodonæus*, in his, of *All in general*, an attempt perhaps a little too bold, and in ſome places but indifferently executed, eſpecially in the laſt Edition, *Ann.* 1644. at *Antwerp.* In this firſt diſtill'd Water, now, of Plants, I deſignedly cautioned you, that we have nothing but thoſe vertues which reſide in ſome part, that will become volatile in this degree of Heat: For the proper and ſingular efficacy of Plants, conſiſts in a mixture of all their Juices together, and hence will depend not only upon this Water, but upon this, and the Liquor that remains after this is drawn off, mixed together. Thus the expreſs'd Juice of freſh Mint, for inſtance, beſides the diſtill'd Water, contains likewiſe a great many other parts that are perfectly diſtinct from it; and hence the vertues of the diſtill'd Water, and native Juice will be very different; which is worth the Phyſician's notice.

10. The ſecond Water, now, wants the volatile part of the Plant we have been treating of, and at the ſame time ſcarce carries up the more fix'd, except that it contains ſomewhat acidiſh, and vapid. If after this is drawn off, you put freſh Rain-water upon the *reſiduum* of the Herb, and boil it pretty ſtrongly, there will come over a more acid Water, but which will contain hardly any thing of the proper vertue of the Plant, the very ſame acidity riſing at laſt from almoſt every ſort of 'em. This I have ſo evidently found to be true by Experiment, that I'll venture to ſay, that the anthelmintic vertue, which ſome very famous Phyſicians have obſerv'd in ſome of theſe diſtill'd Waters, was owing to the Water's having, by its acidity, corroded the Copper, and thus having acquir'd a power that did not properly belong to it. In the mean time, however, we learn from this Operation, that there is an acid Salt in Plants, which may be ſeparated from them, and render'd volatile in 215 degrees of Heat. And we learn from Experience, that this Water has no other vertue than a cooling one, as appears by making uſe of a glaſs Head inſtead of a copper one, for then the Water will not be tainted.

11. This is the beſt method of preparing the common diſtill'd Waters of the Shops, if care is but taken not to mix the ſecond Water with the firſt, for then it will be ſpoil'd. It will loſe its vertue too, with keeping, ſcarce holding very good for a year, but degenerating in the manner that has been already mentioned.

USE.

1. FROM this Operation then, we learn, what parts thoſe are that are ſeparated from Vegetables by the Heat of boiling Water, *viz.* 1. The Water of the firſt Proceſs. 2. The volatile Oil of the Plant with its inherent Spirit. 3. A ſaline Acid.

2. We hence underſtand farther too, what remains at the bottom of the Still

when theſe three are drawn off, *viz.* the Extract of the third Proceſs, and all the Subſtances produc'd from it by the Proceſſes, 4, 5, 6, 7, 9, 10, 11, 12.

3. We hence ſee, likewiſe, in what part the Smell and Taſte of the Plant reſide, *viz.* in the Water of the firſt Proceſs, the volatile Oil contained in this Water, and the Spirit, whoſe ſeat is in this Oil.

4. And by this means, we eaſily perceive what it is that exhales from Herbs, by boiling, either when they are deſign'd for Food or Phyſic. Thus, for inſtance, if Coſtmary, Chervil, Baum, or Smallage are boiled in Broth, they loſe their proper Smell and Taſte, and the vertues that depend upon them, and retain nothing but what is common, and not very grateful: But if you cut them very ſmall, and put them in when the Broth is ready and boiling hot, and then ſtew them a little in a cloſe Veſſel, they will communicate to the Broth their proper vertues. That fine Spice Cinnamon, yields a very grateful Water, that wonderfully warms and enlivens, which being drawn off, there follows an acid one, and there then remains only a refrigerating, acid, rough Decoction, which one wou'd take for a Decoction of Oak.

5. Hence it evidently appears, that vertues directly contrary to one another, riſe from the ſame Vegetable, by the very ſame action of the Fire; for ſo long as an aromatic Plant gives out a Water that is milky, this attenuates and heats; whereas the clear thin one that comes off afterwards, is acid, and cooling.

6. And laſtly, hence we ſee the proper method of diſtillation; for if you deſiſt, as ſoon as ever this white Water has done running, you will have a good valuable Liquor; but if you then, out of greedineſs to have a greater quantity, ſtill proceed, you will mix this laſt acid Water with the former, and by this means ſpoil it. In the mean time, however, let me caution you, that the diſtill'd Waters of Vegetables that have but little Smell, nor any of this warm aromatic vertue, may nevertheleſs be endued with qualities that are very efficacious, tho' Perſons generally think otherwiſe. But upon this head, you may conſult if you pleaſe what we took notice of p. 11. Nor that the native properties of Plants are ſomewhat altered by boiling, do I at all deny. Theſe then are the Uſes of this Proceſs. The Roſemary that remains now after the Operation is over, is green, and retains intirely its proper figure, but is depriv'd of its natural Smell and Taſte.

PROCESS XVI.

Common diſtill'd Roſemary-water, diſtill'd again with freſh Roſemary, call'd Cohobation.

APPARATUS.

1. FROM the laſt Proceſs we learn'd, what it is that Fire and Water are able to ſeparate from Vegetables in cloſe Veſſels, and what they leave behind: In this we ſhall ſhew you a method of opening them more efficaciouſly, and managing them in ſuch a manner, that their diſtill'd Waters ſhall be much more impregnated with thoſe vertues which we recommended in the former.

2. To this purpoſe we take all the Herbs and the Liquor that remain in the Still after the Water is drawn off by the former Diſtillation, and putting them into a Cloth, ſqueeze them very dry, that we may have all the Decoction without any loſs. With this then we mix all the diſtill'd Water prepar'd by the preceding Proceſs, and put them again into the Still, with as much more freſh Herbs as were uſed in the firſt Operation ; and then, if there is occaſion, add as much Water as is neceſſary to keep the proportion there aſſign'd.

3. Let this Compoſition be digeſted in very cloſe Veſſels, with a Heat of 150 degrees, for three Days and Nights, that the Plant being macerated for ſo long a time in its own Liquor, may be open'd, reſolv'd, and diſpos'd to give out its proper vertues very eaſily : And this is call'd *Digeſtion* ; which if it is continued for this ſpace of time, is of great ſervice, but if it is protracted too long, induces a change tending towards putrefaction.

4. The Diſtillation muſt then be performed in the ſame manner as the former, except that a little more caution is neceſſary, and you muſt proceed more gently at the beginning; for the Liquor of the former Herbs is now thicker, and therefore produces more Air, and riſes up higher when it comes to be expoſed to the Fire, by which means when it comes to boil, it more eaſily runs over into the Worm. When about half the Water, however, that is to be drawn off is come away, you may then prudently make your Fire ſtronger.

5. If the Diſtillation is carried on, according to the cautions given before, ſo long as you have any of the firſt Water deſcribed in the laſt Proceſs, and you then deſiſt, this Water will be whiter, thicker, more ſcented, ſapid, frothy, and turbid, than the former; and it will then be able to retain its vertues, which are ſtronger than the former, for a longer time. And hence the vertues proper to any particular Plant, ſo far as they reſide in this volatile odorous part, are procured more efficaciouſly by this method, than the preceding: And the Decoction too that remains after this ſecond Diſtillation, is much ſtronger than the firſt. And as this Operation may be repeated as often as you pleaſe, you may thus conſtantly procure a more generous Liquor than you had before, and a ſtronger *reſiduum* at the bottom, by which means one may at laſt obtain a very choice Water. In this manner I diſtill'd ſome Baum this year 1730, fourteen times, that I might learn with certainty what wou'd be the conſequence, and I found that the laſt Water that was drawn from it, had an exceeding fragrant ſweet Smell of Baum, and a very grateful Taſte, ſo that both the Smell and Taſte of it was really reviving. Nor was this at all to be wondered at, as all the volatile vertue of a great many baſkets of Baum, was now collected within the compaſs of one Bottle, whilſt the other inſpiſſated part that remained at the bottom of the Still, which was of a rough, pleaſant Taſte, and very corroborating, wou'd only fill another. By mixing together therefore theſe two Liquors, one might have the particular vertues of a very large quantity of Herbs in a very ſmall compaſs. This Operation, from *Coaptando*, perhaps, is by the Artiſts called *Cohobation.* By this method, now, not only the moſt valuable diſtill'd Waters, but the beſt medicinal Extracts are prepar'd likewiſe, from a proper mixture of which may be obtain'd ſuch a *compendium* of almoſt the intire vertues of Plants, as is ſcarcely imitable in any other manner : For their native powers are not much alter'd by this Operation, leſs certainly than they are by others. I am ſenſible, indeed, that there will be

ſome alterations occaſioned by the long boiling; but ſtill, that the proper Nature and Vertues are very conſiderably retained, the Smell, Taſte, and Effects ſufficiently demonſtrate.

6. And hence we are certain, that aromatic Vegetables, whoſe medicinal Vertues are particularly ſought after, and reſide in that part of 'em which becomes volatile in boiling Water, I ſay, we are certain, that theſe Vegetables may have their Vertues ſo collected together, and reduced into ſo ſmall a compaſs, as to become much more efficacious than they are in their natural ſtate. Nor are there here any known limits, but, by a repetition of the ſame Operation, their powers may be increaſed as long as ever the Operator pleaſes: Which is certainly a valuable Property of the Chemical Art. *Paracelſus* formerly aſſerted, that he had diſcover'd by Experiment, that there was a peculiar Vertue reſiding in Baum, called by him the *virtus ſpecificata*, which, ſhou'd it inſinuate itſelf into the Humours of the Human Body, wou'd in the decline of Life reſtore them to a youthful Vigour, and by this means radically extirpate the Gout: And honeſt *Iſaac Hollandus* promiſed as great things of it. If what theſe Perſons tell us therefore is true, I thought I cou'd collect this Vertue beſt, and render it moſt efficacious in the Water deſcrib'd, and have taken of it myſelf in the morning faſting, with excellent ſucceſs. In Hypochondriacal, and Hyſterical Diſorders, in *Chloroſes*, and Palpitations of the Heart, when theſe ariſe rather from a Perturbation of the Spirits, than from a collection of any morbific Matter, certainly, you will ſcarce find any Medicine of equal ſervice, though it's true, it's a pretty expenſive one. By cohobating ſome criſp Mint, three or four times I procured from it a balſamic, penetrating Liquor, which, in ſtrengthening a weak Stomach, in cold, viſcid, mucous, pituitous Diſorders of the Stomach, in vomitings ariſing from this cauſe, and Lienteries, proved an incomparable Medicine, giving ſuch ſpeedy relief, as nothing exceeded it. Nor can I enough commend the Water that I prepared in this manner, from Lemon-peels, which though taken but in a ſmall quantity, by the fragrance of its Smell, and penetrating ſweetneſs of its aromatic Taſte, proved of excellent ſervice in *Flatus's*, *Syncope's*, Languors, and Palpitations of the Heart. Wormwood-water likewiſe, prepared from the green Herb by frequent cohobation, has very happily ſupplied the defect of the Bile, aſſiſted the languid chylopoietic Organs, deſtroy'd Worms, and diſcharged them out of the Body. The tops of Savine, which I here cohobated before you, yield a Water too, which at once puts all the Nerves in motion, with ſuch an *impetus*, as is ſcarcely credible. And hence, for aſſiſting the expulſion of the *Fœtus*, promoting a diſcharge by the uterine and hæmorrhoidal Veſſels, and warming the Body, it is an excellent Medicine, if it is but given at a proper time. And as to the Water procured from Rue, by the ſame Operation, can I ſufficiently extol its Vertues? In Epileptical and Hyſterical Diſorders, expelling of Poiſons, and promoting Sweat and Perſpiration, is there any thing more efficacious? Not to mention the Water diſtilled in this manner from Juniper-berries, and the *Arbor Vitæ*, which do ſuch ſervice in Dropſies; or that from Camomile-flowers, ſo beneficial in Tertians; for of theſe things there wou'd be no end. Many of theſe Waters I have here left therefore for your own Examination. From what has been ſaid then, I think it is abundantly evident, which is the true, and con-

ſequently the beſt method of preparing chemical diſtill'd Waters. There are a few Rules, however, that contain ſome cautions, by the knowledge of which, the Operator will be able to apply theſe two inſtances of Diſtillation and Cohobation, given in general, to any other Vegetables that may require ſome particular management:. Theſe therefore I'll now lay before you.

1. Aromatic, balſamic, oily, reſinous, and gummy-reſinous Plants, thoſe that ſmell ſtrong, and retain their ſcent a great while, ſuch, for inſtance, as the *Arbor Vitæ*, the Orange, Hyſſop, Juniper, Bay, Marjoram, Baum, Mint, Origany, the Pine, Penny-royal, Roſemary, and Sage; ſuch as theſe, I ſay, being gently dried in the ſhade, and then digeſted in a cloſe Veſſel for 70 hours, in a Heat of 150 degrees, will, if they are then diſtilled according to Art, yield the beſt Water.

2. But when you want to draw a Water from Barks, Wood, Roots and Seeds, that are denſe, heavy, reſinous, hard, or tenacious, theſe muſt be macerated in a ſufficient quantity of ſalt Water, for three, four, or more Weeks, in a Heat of 90 degrees, and in very cloſe Veſſels, that by this means their ſubſtance may be opened and diſpoſed to an eaſier diſtillation. And in this caſe a pretty deal of Sea-Salt is added, partly to open them, but more particularly to preſerve them from putrefaction, which, in ſo long a time, and in ſuch a degree of Heat as the Operation requires, wou'd certainly happen, and intirely deſtroy their Smell, Taſte, and Vertues. In this manner, for inſtance, muſt be treated Aloes-wood, Roſe-wood, Box, Cedar, Juniper, and the like.

3. Vegetables that diffuſe their Scent plentifully, and loſe it in a ſhort time, muſt be gathered in a proper time, and be diſtilled immediately, without being at all digeſted. Thus Borrage, Bugloſs, Jeſſamy, White Lilies, Lilies of the Valley, the *Philadelphus*, Roſes, Lime-flowers, and the like, will not bear heat, digeſtion, or long keeping. And there are ſome Woods of this kind likewiſe; for Shavings of Saſſafras, if you boil them in Water, ſoon loſe their Strength, Smell, and Taſte; but *Guaiacum*, by being boil'd a great while, makes the Decoction better.

4. The aſtringent, nutritive, anti-alcaline, anti-ſeptic, conſolidating, demulcent, emollient, mealy, gelatinous, refrigerating and ſtyptic Vertues of Plants can never in this manner be communicated to theſe Waters, but muſt be ſought for in the whole Body of the Plant, or in ſome more fixed part of it. Pharmacy, therefore, may be eas'd of the unneceſſary trouble of preparing diſtill'd Waters for any of thoſe purpoſes; and the Phyſicians ſhou'd remember to look for theſe Vertues, in Infuſions, Decoctions, *Defrutum's*, *Sapa's*, and ſuch kind of Preparations. Wou'd it not be an idle thing to expect the very leaſt degree of nouriſhment, in the inert, vapid Water diſtill'd from Barley? Or who wou'd not be laugh'd at, that hop'd to find the ſame in the nauſeous Water drawn from the chopp'd Fleſh of a Capon? Who wou'd ſeek for the Vertues of Sorrel, which are ſo excellent in a hot, lax, putrid, bilious habit of Body, in the Water diſtill'd from this Plant? Nor will you be leſs diſappointed, if you hope to find the inimitable Vertues of Plantain there. Let all theſe things be baniſhed out of the Art, therefore, as puerile and trifling. In ſerious affairs let us be ſerious.

5. But the caſe is vaſtly otherwiſe in thoſe Plants where the peculiar Vertue reſides in that part of 'em, which will be ſeparated from the Plant, and become volatile in a Heat not exceeding 214 degrees; for in the Waters rightly prepared from theſe is contained all this Vertue, which is loſt if you endeavour to obtain it in their Decoctions, or Extracts. Certainly the efficacy of Lavender-flowers, Lilies of the Valley, and Rue, ſo much extoll'd in that kind of Epilepſy, that ariſes from a diſordered *impetus* of the animal Spirits, is preſerved in their diſtill'd Waters, but loſt intirely in their Decoctions, and Extracts; though, on the other hand, the anti-epileptic Vertue of Piony is found in its decoction, and not in its Water.

6. But there are ſome Plants, which contain medicinal Vertues in that part of them that is volatile in the degree of Heat abovementioned, whilſt, at the ſame time, after theſe are ſeparated from them by diſtillation, they ſtill retain other efficacious ones in the *Reſiduum*, and its Decoction. In this caſe, therefore, the Decoction ought by no means to be thrown away, but ſhou'd be inſpiſſated in a broad Veſſel with a moderate Heat, that it may be fit for keeping; and then theſe two may be afterwards mixed upon occaſion, and ſo you will have the united Vertues of the Plant. Wormwood, Mugwort, *Carduus Benedictus*, the leſſer Centaury, Germander, Camomile, Ground-Pine, Roſemary, Sage, Water-Germander, and many others, are referr'd hither. Theſe Herbs, now, by a previous fermentation, are diſpos'd to yield better diſtill'd Waters, but then if their remaining Decoctions are inſpiſſated, there is leſs of the Juice of the Plant in them; or it is more degenerated from its native diſpoſition.

7. An acid, bitter, rough, ſweet, or flat Taſte ſeldom riſes from Plants in Diſtillation, but generally remains in the Extracts. In Wormwood, Camomile, and a few others, it does aſcend. The Colour of Plants too is hardly ever carried up with the Water: In Camomile-water, however, there appears a blue Colour, and in a Wormwood-water, a green one; but this reſides more properly in the Oils that are in them, than in the Waters themſelves. But the ſaponaceous qualities of Plants ariſing from their Salt and Oil combined together never riſe in Diſtillation, but remain in the Extracts.

8. Vegetables, therefore, endued with the laſt mentioned properties, are not made uſe of for this Operation. See the Catalogue annex'd to the ſecond Proceſs, and what was ſaid under the fifteenth. Thus Sorrel, Ladies-mantle, Berberries, Bete, Cabbage, Cherries, Succory, Endive, Strawberries, Lettice, the acid Juices of Oranges, Citrons and Lemons, Purſlain, Currants, Elderberries, Viper-graſs, and Ripe-grapes, give out ſcarce any thing valuable in their Water.

9. But in the laſt place we may take notice, that the very ſame Vegetable ſometimes contains very contrary properties: Thus, the firſt Water drawn from Cinnamon opens, warms, moves, quickens, ſtimulates, and ſtops vomiting; the ſecond is aſtringent, cooling, and nauſeous; whilſt the Decoction that remains in the Still, which is of a browniſh-red colour, opake, thick, without any Smell, and of a rough Taſte, has an aſtringent, coagulating, corroborating and binding quality.

PROCESS XVII.

Common diſtill'd Roſemary-water, drawn from the green Plant, fermented according to the method of Ludovicus.

APPARATUS.

1. THE effects of Diſtillation, Digeſtion, and Cohobation taken notice of, having ſufficiently diſcover'd to us the action of ſuch a Fire upon Vegetables, as is determin'd by the degree of heat of boiling Water, in Diſtillation and Cohobation, and of a ſofter aſſiſted by Water in Digeſtion, I here always, for the uſe of the Phyſician, explain another elegant and uſeful method of treating them, by which their medicinal Vertues are very little altered from their natural diſpoſition, and yet are rendered more penetrating and volatile. To this purpoſe then take green Roſemary, in ſuch circumſtances as are directed in Proceſſes 1, 15, 16; let it be cut and pounded, if it appears neceſſary, and then fill an upright oaken Cask with it, till it reaches within four fingers breadth of the top. Upon this pour as much Water as is requiſite to fill the Veſſel to the ſame height with the Roſemary, and to this add about an eighth part of Honey, if it is in the Winter, and the Weather is cold; about one twelfth, if it is in the Summer: Or if, inſtead of Honey, you uſe the ſame quantity of common, fat, brown Sugar, the effect will be the ſame: Or, in the room of theſe, you may add half an ounce of Ale Yeaſt to every pint of Water, and by this means too you will be able to procure a good Liquor: The *Mulſa*, however, with the Honey I prefer to the others. Let a ſufficient quantity of this Water and Honey, therefore, made warm, be poured upon the Herbs in the Cask, and let the Bung-hole at top be ſlightly cover'd with a wooden Bung. Let the Cask then, with its contents, be ſet in another wooden Veſſel, and put a Pan in with it, with a live Coal thinly covered with Aſhes, that to the Liquor and Herb may be communicated a Heat of near 80 degrees. When you obſerve this to be the caſe, cover the whole over with a Blanket, and, by moderating the Fire, let it be conſtantly kept in this degree of Heat. Hence, in a cold Winter ſeaſon, more Fire is neceſſary, and more care requir'd, that it don't grow cold, whereas in the heat of Summer, you will want but very little, if any aſſiſtance from the Fire. Theſe cautions being properly obſerved, there will, the ſecond Day, begin to ariſe in the Liquor a hiſſing Noiſe, with Bubbles, and a frothy Head, and there will be diffuſed a fragrant Smell of the Roſemary, which will then riſe to the top of the Liquor; and this Motion is called Fermentation.

2. When this Fermentation has proceeded ſo long, that the Herb, which before was brought to the top, begins to ſubſide, and ſink to the bottom of the Cask, it has then continued long enough for this Operation, for which reaſon you muſt then let the Veſſel cool, and ſtop it up cloſer: For if the Liquor is kept any longer in ſo great a degree of Heat, in an open Veſſel, the Spirits, and Oils, which are now rendered more volatile, will fly off, and by this means you will loſe the Vertues you are ſeeking for; and hence, when the Herb is thus prepared, the ſooner it is diſtilled, the better.

3. Take as much then of this Herb, and its fermented Liquor, as will fill your Still to two thirds, and diſtill cautiouſly at the beginning; for as this Liquor ſtill contains a great deal of fermenting Spirits, hence it eaſily rarefies with the Heat, produces a Scum, puffs up, riſes into the Still, and thus diſturbs the Operation. And as theſe things are more apt to happen in this caſe than the preceding, hence, the not attending to 'em will be here of worſe conſequence, eſpecially at the beginning. This caution then being obſerved, there will firſt come over a limpid, pinguious, penetrating, ſcented, ſapid Liquor, which muſt be carefully kept by itſelf. When this is drawn off, there will ſucceed a milky, opake, turbid Liquor, that will ſtill retain ſome Smell and Taſte of the Roſemary. After this you will have a thin, acid Liquor, without any Scent, and that will contain ſcarce any thing peculiar to the Roſemary; and in the Still there will remain an extract, with reſpect to the Herb pretty effete, but containing a great deal of the ſubſtance of the Honey. And this will be always found to be the caſe, if the Fermentation is carried on juſt till the Herb ſpontaneouſly ſinks to the bottom, which generally, in the degree of Heat directed, happens the fifth or ſixth day. This firſt Water, now, or rather Spirit, if you do but keep it in a cloſe Veſſel, may be preſerved for years without alteration, nor will ſo much as grow mucilaginous. The Scent and Taſte of its Plant, it retains excellently well, though a ſmall matter altered. But if you either mix leſs Honey with your Water, apply a gentler degree of Heat, or continue the Fermentation for only two or three days, then, in the Diſtillation, the firſt Water that comes over will be white, thick, opake, pinguious, and frothy, having intirely the Smell and Taſte of the Plant, leſs alter'd than in the former caſe, but, at the ſame time, not ſo penetrating, nor ſo warm. After this is drawn off, you will have, as before, an acidiſh, limpid, inodorous Water; and the Decoction remaining in the Still will have much more of the peculiar properties of the Roſemary than the former had. And in this caſe, too, there almoſt always appears ſome Oil in the firſt Water, which there did not in the former Spirit. But again, if you ferment the Herb for only one day, or a day and a half, then in Diſtillation, the Water that riſes firſt will have a great deal of Oil ſwimming at top of it: In other reſpects, it will proceed pretty nearly as the others: The longer, therefore, the Fermentation is protracted, the leſs diſcernable will the Oil be in the Diſtillation, and the firſt Water will be always ſo much the clearer and ſtronger; but then if you mix it with fair Water, it will in an inſtant become milky. Hence therefore theſe Waters will be found to be very different from one another, according as you prepare 'em by one or other of theſe methods.

4. If in the firſt more perfect Fermentation, after you have drawn off the firſt clear Water, and the ſecond milky one, you boil the third, acid, limpid, thin one ſtrongly, and too long, you will have a Water that will be almoſt as ſour as Vinegar.

5. The Extract that remains in the Still will be always ſo much leſs impregnated with the native Vertues of the Plant, as the preceding Fermentation has been longer protracted, and is more perfect; and the contrary.

6. The Oil likewiſe of the Plant, which in the 15th and 16th Proceſſes evidently ſwam at top, in diſtill'd Plants, firſt thoroughly fermented, becomes ſo attenuated as intirely to diſappear, and in the firſt diſtill'd Liquor is ſo minutely di-

vided as to lie concealed: Hence, therefore, theſe are more properly Spirits, than Waters. And that this is the caſe, appears evidently, by pouring them into a large quantity of Water, for then by the whiteneſs that they immediately acquire, they diſcover that they contain a latent Oil, nay, ſometimes, to ſuch a degree, that the Oil thus regenerated, ſwims at top of the Water in form of Drops.

7. Hence, therefore, it is evident, that if this Fermentation is continued for a proper time, with a large quantity of Yeaſt, and then the whole is kept for ſome time cloſely ſtopt up in a wooden Caſk; then the Water that is drawn from it will be exceeding clear, warm, aromatic, odorous, ſapid, and penetrating, without the leaſt of Oil in it. But then in proportion as theſe qualities are more exalted, the proper characters of the Plant are found to be altered, ſo that if the Fermentation is ſuffered to be quite compleat, they are ſo deſtroy'd, as ſcarcely to be diſtinguiſhed from one another. And hence it appears farther, that the peculiar vertues of Vegetables are not ſo much advanced and perfected by Fermentation, as they were by the preceding repeated Cohobation; and on the other hand, that by a repetition of that Operation, the Waters were not rendered ſo ſpirituous, as they are here by one ſingle Fermentation. And the reaſon of this ſeems to be, that by the active motion of a long protracted Fermentation, the volatile *Spiritus Rector* is ſet free from the opened parts of the Plant, the attenuated Oil in particular, and ſo exhales; for the tenacity of the Oil is the principal *Vinculum* which holds down, and retains this Spirit in its proper Body. In the mean time, however, a gentle and moderate Fermentation, that is not great enough to diſſipate the Spirits, and yet is ſufficient to diſſolve the impeding Viſcidities, wonderfully quickens theſe Waters, makes them durable, preſerves them from corruption, growing thick, or mucilaginous. This that excellent Chemiſt, and candid Writer *Daniel Ludovicus*, elegantly obſerved in his Pharmacy, to which we ought in the preſent Age to have a proper regard. The Water, certainly, drawn from *Carduus Benedictus*, prepared in this manner, is vaſtly extolled for promoting of Sweat and Perſpiration.

8. The Smell and Taſte, therefore, of Plants with which diſtill'd Waters are impregnated, depend particularly upon the *Spiritus Rector* proper to the Plant. But as this Spirit is retain'd in its Body by a tenacious ſulphureous *Vinculum*; hence the more of this Oil there is mixed with theſe Waters, the more ſcented and ſapid will they be in proportion. This Oil, it's true, by Diſtillation, Digeſtion, and Cohobation, grows gradually thinner, leſs tenacious, more ſpirituous, and more eaſily miſcible with Water, and by this means the *Spiritus Rector* is more diſengaged, becomes more volatile, and is ready to fly off; but then, as the Digeſtion and Diſtillation may be performed in very cloſe Veſſels, it may be retain'd, mix'd with the Waters, and render them exceeding efficacious. Fermentation, on the other hand, now, takes up a conſiderable time, requires a free admiſſion of the Air, and muſt be carried on in an open Veſſel; and hence at the ſame time, that by its inteſtine motion, it attenuates the Oils, renders them capable of being diluted in Water, and of ſupporting Flame, it muſt neceſſarily diſſipate the native Spirit. It diſpoſes the Oil, therefore, to mix more readily, and intimately with our Fluids, and to penetrate more eaſily into the minuteſt Veſſels, but then it always deprives the Plant of its ſingular

diſtinguiſhing quality. In the mean time, however, this Water ſtimulates the Nerves in a manner not diſagreeable, thoſe particularly of the Noſe, Mouth, *Fauces*, *Æſophagus*, Stomach, and Inteſtines.

PROCESS XVIII.

Diſtill'd Roſemary-water drawn from the green Herb per Deſcenſum.

APPARATUS.

1. DISTILLATION was by the ancient Chemiſts defined to be the motion of Bodies, by the help of Fire, out of one Veſſel, containing the Matter to be changed, and expoſed to the Fire, into another Veſſel applied to the former; and that, whether Liquids were treated in this manner, or ſolids; or whether Liquids were ſeparated by this means from liquid Bodies, or ſolid ones. And this they ſaid might be performed after three different manners: For either, firſt, the Fire carries the diſtill'd matter upwards out of an upright Veſſel; or ſecondly, raiſes it to a ſmall height, and then carries it off laterally, as in Diſtillation with a Retort; or thirdly, the Fire being placed at top, or about the ſides of the Veſſels, occaſions the diſtill'd Subſtances going downward, which they called Diſtillation *per Deſcenſum.* This in former Ages was made uſe of for the ſeparation of Mercury from its foſſil Glebes; and this *Paracelſus* afterwards applied particularly to the Diſtillation of Vegetables. This Operation will beſt appear by an Example. Take then a cylindrical Veſſel, of what breadth you pleaſe, but pretty deep, and made of ſuch matter as will neither imbibe the Liquor, let it perſpire, or taint it. Near the top of this Veſſel, on the inſide, let there be a rim to ſupport a round iron Plate full of Holes, which muſt fit the Veſſel exactly, and when it is placed within it, be two inches from the top. Upon this, then, lay a freſh, green, ſucculent Plant, cut, or pounded, ſo that it may riſe juſt even with the top of the Veſſel, upon which lay a flat Cover exactly fitted to it, and let the cracks between be ſtopt up cloſe with Clay, that none of the Vapour may be able to make its way through: Upon which head you may conſult *Andreus Libavius.* If you have occaſion to uſe this inſtrument often for diſtilling ſuch Waters, it is beſt made of plates of Iron; otherwiſe, juſt for one Demonſtration, an earthen one is ſufficient.

2. Every thing then being thus diſpoſed, upon the Cover ſpread a thin *Stratum* of Aſhes, and upon this lay ſome Fire, that by the Heat of it, the moiſt parts of the Plant, may be diſſolved into a Vapour, and its Juices being fus'd, may deſcend into the Veſſel underneath, where they will be condenſed by the Cold, and diſtill in drops. And thus, if you prudently increaſe your Fire, the humid parts of the Plant will be carried downward, and there collected, *viz.* the Spirit, Water, Wax, Gum, Oil, Reſin, and a ſaline ſaponaceous Matter, which cou'd not be ſo eaſily ſeparated by the preceding methods of Diſtillation.

3. In this Operation, however, you muſt be very careful you don't make your Fire ſo great to burn the Plant; for if you apply a ſtrong one at firſt, you confound all together, and the oily parts are burnt, by which means the

Liquor drawn off acquires an empyreumatical, ſooty, bitter Taſte and Smell, which makes it very nauſeous, and not fit for medicinal purpoſes; which happens particularly in Vegetables that are dry, and oily: And yet it muſt be confeſs'd, that a ſmall Heat has but little effect.

4. But when Plants are very ſucculent, as the *Petala* of Roſes, for inſtance, and you manage them carefully without burning them, then the Waters prepared in this manner come neareſt to the native Juices, as they even contain their ſaponaceous quality, and poſſeſs their proper vertues, tho' they are always indeed a little changed by the Fire, for which reaſon, as their expreſs'd Juices are always more grateful, ſo for medicinal purpoſes they are beſt likewiſe. *Paracelſus* treating *Guaiacum* in this manner, converted it into an acid Liquor, and acrid fetid Oils, which nevertheleſs he commended both for external, and internal uſes; and hence this Operation was in repute for ſome time among the *Germans*, tho' now it is almoſt out of uſe, as there are others that are neater. Let it ſuffice, therefore, that you have thus underſtood the nature of it, and juſt ſeen an inſtance of it.

PROCESS XIX.

Salt Aſhes procured by burning the Reſiduum *of the* 15*th*, 16*th*, 17*th*, *and* 18*th Proceſſes, as in the* 5*th*, 6*th*, 9*th*, 10*th*, 11*th*.

APPARATUS.

1. IF the *Reſiduum* of the fifteenth Proceſs, as well the Herb as the Liquor that remains after Diſtillation, is put into an earthen Veſſel, and evaporated to a dryneſs, and is then taken out, and in an iron Frying-pan burnt upon an open Fire to white Aſhes, as in the ſixth Proceſs, then from theſe Aſhes may be procured a large quantity of Salt, ſuch as might have been obtain'd by burning the crude Plant before the Diſtillation; both the Aſhes and the Salt produced from it being perfectly the ſame, as you will find upon examining them in this Plate, which I ſhall here leave for you. And if you take the Decoction remaining in the Still without the Herb, and add to it all the Juice you can preſs out of the Herb, when it has been thus diſtill'd, then if you prepare a Salt from this Liquor, as in the fifth Proceſs, you will have the ſame Aſhes as in that Proceſs, together with the ſame Salt, and nearly the ſame quantity. This Diſtillation, therefore, does not leſſen the quantity of Salt.

2. If you treat the *Reſiduum* of the ſixteenth Proceſs in the ſame manner, taking either only the Liquor, or both the Liquor and the Herb, the Aſhes you procure by this means will be twice as Salt as the preceding, and you will have the ſame kind of Salt, but in quantity twice as much. And if you repeat this Diſtillation ſixteen times, as I mention'd in the Cohobation of Baum, the laſt Liquor that remains in the Still, if it is dried and burnt, will yield ſixteen times more Salt than you wou'd have procur'd by one ſingle Diſtillation. Hence, therefore, it appears, that by Cohobation the *Reſiduum* increaſes in its ſaline, and ſaponaceous vertue, as the cohobated Water does in its volatile part, abounding in Spirits and Oil. And hence is diſcovered a method of exalting the proper vertues of Vegetables, as much as the Operator pleaſes, ſo that here

it is true, if any where, that Art goes beyond, and excels even Nature it ſelf. And from the whole too we learn farther, that Cohobation, tho' ſo often repeated, does not diminiſh the ſaline Matter that reſides in the more fix'd part of Vegetables, provided we do but take a proper care that the Herb ſuffers no degree of Putrefaction.

3. But again, if you take Herbs that are fermented without Honey, or Sugar, and diſtill them according to the ſeventeenth Proceſs, and in the ſame manner burn the *Reſiduum* to Aſhes, as you ſee I have here done, you will by this means too, have the ſame quantity of the ſame Salt: So that here it appears too, that this kind of Fermentation does not render volatile that Matter of Vegetables, which when it is burnt, yields the fix'd Salt. This certainly now wou'd have appear'd very ſurprizing, had it not been already known, that Tartar of the moſt perfectly fermented ſubtil Wine, when it is burnt, yields a fix'd Salt in a very great quantity. But now, if when you have fermented Roſemary with Honey, you diſtill it, inſpiſſate the *Reſiduum*, and reduce it to Aſhes, you will then have ſuch only as I have here ſet before you, which are ſcarcely acrid, nor will eaſily yield any ſuch Salt: For as for the Coal that will be produc'd from the Honey, that will not be readily converted by the Fire into a ſaline Matter, but will remain ſpongy as it were, and not acrid.

4. And laſtly, if you burn the *Reſiduum* of the eighteenth Proceſs, you will be able to procure ſo much leſs Salt from it, as there is more of the ſaline ſaponaceous Matter gone down with the Water: If you have drawn off, therefore, but a very little Water, you will then have pretty nearly the ſame quantity of Salt remaining in the *Reſiduum*, as in a common Diſtillation.

5. All theſe things then being carefully attended to, and rightly underſtood, we ſhall be able to come at the knowledge of the true effects of the Diſtillations we have been explaining: For by means of theſe there riſes from Vegetables, 1. The ſimple elementary Water of the Plant. 2. A Spirit in this Water deſcribed in the firſt Proceſs. 3. The volatile Oil of the Plant, call'd by the ancient Chemiſts, their Sulphur; which being mixed with this Water, renders it white; which when it exiſts ſeparately, will not mix with it, and when it is thus mixed with it, gradually diſengages itſelf again; and which principally contains and holds down the former volatile Spirit, from which chiefly it receives its Smell and Taſte, and often very ſingular and extraordinary vertues. This is what I chuſe to call the (*Oleum primi generis*) firſt kind of vegetable Oil; as it is firſt and eaſily ſeparable from them, being intermixed with their Juices, not tenaciouſly united with them, nor adhering firmly to, or being much entangled among their more ſolid parts, nay in many of them being diſpoſed in proper diſtinct repoſitories. And when theſe three parts are ſeparated from a Plant, there ſcarcely remains any of its native Smell or Taſte in the *Reſiduum*. 4. But by this Operation there aſcends likewiſe, a thin volatile acid Liquor, which being of a ſubtil ſaline nature, is not fix'd even in burning Vegetables with an open Fire, but flies off, and therefore may not improperly be called the native Vinegar of the Plant: This in the Diſtillation of Cloves and Cinnamon, riſes with the laſt Water; and this is found to be produc'd from every Vegetable, the hotteſt not excepted, when the three former parts are perfectly drawn off. But in the part of the Plant, now, that does not become volatile by Diſtillation, but remains in the Still, we diſcover, 1. A more fix'd Oil,

combined more tenaciouſly with the *reſiduum*, nor to be raiſed by diſtillation; which is cloſely united with the proper Salt of the Plant into a *Sapo*; which by Decoction in Water may be ſeparated from Vegetables, with its adhering Salt (Proc. 3, 5.); and of which a conſiderable part, when Plants are burnt in an open Fire, is thoroughly blended with this Salt, and intimately fixed with it into an Alcali. 2. An Oil, which for compoſing the ſolid parts of Vegetables is combined with the elementary Earth, by ſo intimate a union, that it cannot by any boiling whatever be ſeparated from it. Proc. 4. 3. The greateſt part of the native and proper Salt of the Plant. 4. That matter of the Plant which, by the action of a ſtrong Fire, is fixed, and converted into a fixed alcaline Salt. 5. And laſtly, the greateſt part of the terreſtrial Elements, as well thoſe which were mixed with the Fluids, as thoſe which entered into the compoſition of the Solids: The greateſt Part, I ſay, becauſe there is a conſiderable quantity of Earth to be procured even from the volatile Oils.

PROCESS XX.

A native Oil of Vegetables procured from them by Expreſſion; here from Almonds.

APPARATUS.

1. IN Plants there is a certain part, either ſpontaneouſly liquid, or readily melting with a gentle Heat, which is called their Oil. This may, however, by ſtanding quiet a great length of time become thick, as we ſee evidently in the moiſt liquid Oil of Turpentine, which will grow gradually thicker and thicker. By Cold likewiſe it may harden and be reduced into ſpherical Bodies, reſembling the Spawn of Fiſh. Nay, and farther, it may be converted into a ſolid Body, of which we have an inſtance in Wax. By whatever means, however, it has acquired a conſiſtence greater than its natural one, upon the application of Heat to it, it will be again reſolved. This Oil, now, when it is in a fluid ſtate, is always pinguious; for it is very ſoft, and being handled, feels ſmooth, and lubricates other Bodies, and yet at the ſame time coheres with a certain tenacity, that is not found in Waters and Spirits. But this Oil too is always inflammable, properly diſpoſed to feed and ſupport both Fire and Flame, and even to be converted into Flame, itſelf; which is by no means the caſe of Air, Water, and Earth. And laſtly, this Oil abſolutely refuſes to be intimately united with Water, but being mixed with it, repels it, and collects itſelf together, by which means they become ſeparated again into two diſtinct Liquids. A vegetable Oil, therefore, is a pinguious, inflammable Liquor, that is not miſcible with Water.

2. This Oil, now, is found in Plants to be of different Sorts. Thus the volatile Oil, which is drawn from oily Vegetables, in the diſtillation of their Waters, contains in it the *Spiritus Rector*, which gives to every Plant its peculiar Smell and Taſte. Hence you find in this Oil the ſingular properties of the Plant, ſo far as they diſcover themſelves to the Senſes, which being thoroughly ſeparated, the *reſiduum* has nothing of its diſtinguiſhing Character. Thus, for inſtance, if a Perſon in this manner accurately extracts all this Oil from

Cinnamon, Mace, Cloves, or Nutmegs, he will ſee indeed the perfect form of the Spice in the remainder, by which he will be able to know it, but as for its peculiar qualities, he will find nothing of them, neither their Smell nor Taſte diſtinguiſhing them from one another. The ſubſtance even of this Oil, however, does not properly poſſeſs this Smell or Taſte, but receives it only from the abovementioned Spirit, which, whilſt it reſides in them, makes them different from one another; for when this is gone off, they can ſcarcely be any longer diſtinguiſh'd, but appear to be nearly of one and the ſame Nature.

3. But in particular parts of ſome Vegetables there is an Oil found quite pure, collected in little diſtinct repoſitories, or follicles, which may be properly call'd, adipoſe ones; but this caſe excepted, they are mixed with the other Juices of 'em, and by this means are divided, and ſcarcely appear as Oil, but the oily Particles lie concealed in the form of a ſaponaceous ſubſtance: Theſe, however, as ſoon as ever they are ſeparated from the other Bodies they are united with, and are collected together, diſcover themſelves to be a true Oil. Of each of theſe we have abundance of Inſtances: Thus if the ſaponaceous Juice extracted from Vegetables, by the aſſiſtance of Water, is inſpiſſated, and dried, by its burning it will demonſtrate the admixture of a pinguious Oil. See Proc. 3, 5. And if you make an Inciſion in the Fir, Pine, or Larch-tree, you will have a pure Oil diſtill from the Wound. So if you take the Root of Maſterwort, juſt dug out of the Ground in Winter, and clean it well, and cut it tranſverſly with a ſharp Knife, you may with a Microſcrope obſerve little drops of a golden Oil oozing out of its proper ducts, diſpoſed in a very particular manner. Or if you ſplit a Nutmeg with a warm, ſharp Knife, and then examine the ſurface with a Microſcope, you will evidently obſerve particles of a rich Oil. An Almond too cut and viewed in the ſame manner, diſcovers an exuding Oil, eſpecially if it is firſt made warm, and then gently preſs'd after it is divided. But this Oil never appears more evidently, and in greater abundance, than in the ſeminal Cotyledons of Plants, where it ſerves to defend the tender embryo from any moiſture that might injure it, and ſecure it from too great a degree of cold, which by freezing it might prove fatal to the curious *ſtamina.* This Oil, likewiſe, being by the æſtival Heat, propell'd towards the Bark, and there depriv'd, in a good meaſure, of its watery part, is collected in great quantity, in the Winter ſeaſon, in particular, eſpecially in the Evergreens.

4. The Oils of Vegetables, therefore, abound chiefly in thoſe parts of 'em that are to laſt longeſt, for the defence of others that are of the moſt conſequence; and for this reaſon they are found in thoſe parts particularly that are ſituated at the greateſt diſtance from the abſorbent Veſſels of the Root, and conſequently are fartheſt from the nutritious Juice drawn out of the Earth. Thus in Linſeed, when it is ripe, you'll find more Oil than perhaps in the whole body of the Plant beſides.

5. But ſometimes this Oil is collected in ſo great quantity as to burſt its repoſitories, run out, and appear in the true form of Oil; and this, in particular, is obſerved in the Bark, and the Fruit. This we ſee in the conical Fruit of the Fir, Cedar, Larch-Tree and Pine, and the Berries of the Juniper; but principally, as I hinted before, in the Evergreens, where the outer parts of the Bark is

are often ſmeer'd over with this Oil. In the northern Trees, that are expoſed to ſevere Cold, eſpecially if they ſtand on high mountainous places, or pretty high dry ones, this is remarkably evident. And hence one wou'd be apt to ſuſpect, that this Oil is very neceſſary for their preſervation againſt the freezing cold of the Winter.

6. But we obſerve farther, that theſe pinguious Oils are generated and collected in Vegetables particularly that are adult, and are juſt paſſing into a ſtate of reſt, or are growing old. For both the ſmaller Plants, and Trees themſelves, when they firſt come up, diſcover very little Oil, but are full of a watery thin Juice; and yet when the ſame are come to maturity, they contain an Oil in great quantity. Examine, for inſtance, the Flax, and you ſee the whole Plant, like Graſs, ſeems to be ſupported intirely by Water, and yet, when it grows mature, and changes its green colour for a yellow one, it is abundantly ſtock'd with Oil, particularly in the Seeds: And in a young and old Pine, the ſame thing is very evident. But it is farther obſervable, that your Trees and perennial Plants, as the Autumn comes on, gradually contract themſelves, have the circulation of their Juices vaſtly diminiſhed, ſcarcely perſpire, draw hardly any thing out of the Earth, or diſperſe any thing into the Air; but on the contrary, as the Spring advances, have all their Juices put in motion, imbibe a great quantity of Moiſture out of the Earth, and exhale it into the Atmoſphere. If one might be allowed therefore to call their Autumnal and Winter ſtations their ſleeping ſtate, and their Vernal and Æſtival, their waking one, then it will be almoſt univerſally true, that Plants abound with Oil in their ſleeping ſtate, with Water in their waking one. Examine the Root of Maſterwort in the Winter, when it is deprived of all its Leaves, and lies inactive in the Ground, and is it not then properly aſleep? And at that time dig it up, cut it, and view it, and it will appear full of a rich Oil; whereas, if you take it up in the Month of *May*, you will find it watery, ſaline, and by no means ſo oily: And the ſame thing is true in Trees, likewiſe. But laſtly, as Vegetables grow old, they are often overcharg'd and deſtroyed by the abundance of their Oil, as we ſee in the Fir, Pine, and the like, which at laſt are ſuffocated by their own pinguious Juices, appearing in ſome in the form of a Gum, in that of a Reſin, Oil, or Balſam in others. Hence the Gardiners have the mortification of ſeeing their Trees die ſo often from their Bark's being quite choaked up, juſt in the ſame manner as we ſometimes ſee Animals, overwhelm'd, and ſuffocated with their own Fat.

7. When the Chemiſt, therefore, has a mind to extract the Oils from Vegetables, let him firſt learn from the Botaniſt, that there are ſeaſons in which their Water and Salt are in greateſt abundance, and then they contain a leſs quantity of Oil; and that, on the contrary, there are others, when their Oil chiefly abounds, and there is leſs of their Water and Salt. Thus, for inſtance, whilſt Nature is forming new Leaves, Flowers, and Fruit in Vegetables, there is then carried on a circulation of watery Juices pregnant with Salt, and then the ſlow, tenacious Oils are deficient; whereas, on the other hand, when the Flowers are faded, the Leaves wither and fall, and the Fruit being perfected, and come to maturity, is ready of itſelf to drop off, likewiſe; then the more Juices being diſſipated by the Heat of the Summer, the Oils are collected in greater abundance, diſcover themſelves, and become predominant. And for

this Reaſon the Carpenters chuſe that Wood for building which is fell'd in the middle of Winter, as being moſt durable, reſiſting Water moſt efficaciouſly, nor being ſo liable to rot: For the hardeſt and heavieſt Woods, which ſcarcely feel the effects of time, are found to be replete with Oil, and that a very heavy one too. Thus if we examine Cedar or *Guaiacum*, what a quantity of Oil do we find in 'em, that is very ponderous, and compact? If the Chemiſt, therefore, wou'd moſt advantageouſly procure an Oil, or a Salt from any Plant, he muſt take it, for theſe different purpoſes, at various ſeaſons of the Year.

8. The Oil which is moſt natural to 'em, the greateſt number of Plants contain principally in their Seeds, when they are perfectly ripe, and ready to drop, and hence, from their maturity, are grown in ſome meaſure dry, being chiefly kept moiſt by their own Oil. Theſe, therefore, being cautiouſly a little more dried, are pounded with their Skins into a kind of Meal; but if they happen to be ſo very oily that they cannot, on this account, be reduced to a Powder, then they are pounded only in a ſtone Mortar, by which means their Oil runs from them, as we ſee in Almonds, Pine-nuts, and Piſtach-nuts. The Meal being thus prepar'd, it is expoſed for a little time to the Vapour of hot Water, and then gently dried again, by which means it is more and more open'd, and gives out its Oil more freely. The Meal, then, or the Paſte, where the Seeds are very oily, is put into a hempen Bag, which being tied faſt is placed betwixt two iron Plates, heated in boiling Water, and with a Preſs ſqueez'd very hard, by which means the Oil which is fuſed by this degree of Heat, which does it no harm, oozes through the Holes of the Bag, and drops into the Veſſel placed underneath, never diſcovering any *Empyreuma*, but being nearly natural as it exiſted in the Plant. And by this contrivance an Oil may be drawn from the Seeds of the leaneſt Plants, as Hemp, Lettice, and Flax, in which no perſon living cou'd have believed ſuch a pinguious Fluid cou'd have lain concealed. From the *Indian* Cloves, Mace, and Nutmegs too an Oil of this kind may be expreſs'd in great quantity. In this Oil, however, the very warm, aromatic quality of theſe Spices is not predominant; for that preſs'd from Mace and Nutmegs is rather a pretty mild, thick Balſam, than ſuch a cauſtic aromatic Oil as is produced from them by Diſtillation. I was formerly, I confeſs, very much ſurpriz'd, to ſee the expreſs'd Oil of Muſtard-ſeed preſcribed with ſucceſs in the ſevereſt fits of the Stone; but my wonder was at an end, when upon examination I found this Oil to be ſweet and ſoft, though in diſtillation it appears ſo acrid, nay, perfectly igneous. For the reaſon of this, however, after much conſideration, I am ſtill at a loſs. For why ſhou'd not the pungent Taſte and Smell, ſo predominant in the diſtill'd Oil, appear in the expreſs'd one likewiſe? Or why ſhou'dn't the Acrimony of the *Spiritus Rector*, whoſe ſeat is in the Oil, be here remarkable? Certainly, whether you conſider the Water, Salt, nay, Spirit itſelf, or its Oil, you won't perhaps ſatisfy yourſelves ſo thoroughly as you may at firſt imagine.

9. This Oil contains but a very ſmall quantity of Salt; and yet it has a good deal of the nature of the Plant, as is evident to the Senſes. So long, therefore, as it is freſh, by mixing with our humours, it ſheaths, blunts, and corrects their Acrimony, and being rubb'd upon the external parts, it removes any hardneſs and brittleneſs, and renders the Fibres, Membranes, Veſſels, and *Viſcera* lax, ſoft, and pliable. Dead, dry Eſchars, it moiſtens and ſoftens, and makes them ſeparable

from the Quick with greater eaſe by the vital Actions. In wounds, it ſecures the parts that lie bare from being dried too much by an Air that is dry. It prevents too the fine Fluids exhaling from the open mouths of the wounded Veſſels, which wou'd otherwiſe deſtroy their extremities. In freſh incis'd wounds, therefore, it is of excellent ſervice, as they will, by the help of it, be conſolidated in a ſhort time. And further, by mitigating any ſharp Humours, and relaxing any parts that are too tenſe, it proves a wonderful Anodyne.

10. But how very remarkable is this property of theſe Oils, that in a Heat only of 70 degrees, they will ſo ſoon, without the admixture of any thing elſe, degenerate from their natural diſpoſition? For by this means they loſe their Conſiſtence, Mildneſs, Sweetneſs, almoſt inſipid Taſte, Whiteneſs, and Anodyne and relaxing Quality, and become thin, acrid, bitter, rancid, yellow, corroſive, and inflammatory. And all theſe changes happen in a pretty ſhort time, *viz.* a few Days, if they are expoſed only to an æſtival Heat. But how great is this Alteration? Oil of ſweet Almonds taken in form of a *Linctus*, proves an excellent emollient, where the *Fauces* are grown rough with an *Angina*; and yet if the ſame ſhould be taken by a Perſon in Health, after ſtanding in ſuch a Heat but a few Days, it wou'd corrode and inflame them. And the ſweeter theſe Oils are when they are freſh, the more acrid they grow when they are old and rancid. Hence how abominable are Almonds, Walnuts, and Piſtach-nuts, when once they come to be rancid, and how eaſily will they cauſe an *Angina*, and raiſe a Fever, by inflaming the Throat, *OEſophagus*, Stomach, and Inteſtines? For this reaſon, therefore, when Phyſicians preſcribe Oil of Almonds in acute Diſeaſes, they ſhould take care that it is not preſs'd from bad Almonds, and that in hot weather it ſhould not be above one Day old. The ſame thing is true likewiſe of the Butter, the crude Fat of Animals, their Lard and Marrow, which are their Oil in greateſt perfection. How ſweet are theſe when they are freſh? How abominable when they are expoſed to the Heat of the Summer, without any Salt? Don't they by this means grow yellow, bluiſh, and greeniſh, and become vaſtly acrid, and in a ſhort time acquire a fatal poiſonous quality? And in fat Cheeſe, when it is very old, is there not a moſt corroſive Acrimony? Certainly there is, I have ſeen a Perſon's Lips, Gums, Tongue, Palate, and *Fauces* violently inflamed by it. What effect, therefore, it muſt have in the internal *Viſcera* it is eaſy to imagine. Reflect only, Gentlemen, how ſoon this Oil, when it is boil'd over the Fire, grows yellow, red, black, bitter and acrid, and by this means becomes unwholeſome, and then you will eaſily conceive how this, when it has been in the Stomach ſix hours, may grow exceeding bitter, and then riſing into the Throat and Mouth, may be falſely taken for Bile; whereas if this Matter is ſpit out into the Fire, it will flame and burn. Theſe Obſervations then, concerning the nature of this Oil, will help to give light into a great many things in Natural Hiſtory, Phyſic, Pharmacy, and Cookery.

PROCESS XXI.

If Native Oils, together with the Bodies they reſide in, are rubbed with Water, they yield a Chyle, Milk, or Emulſion: An inſtance here in Almonds.

APPARATUS.

1. IF the oily Subſtances deſcrib'd in the preceding Proceſs are ſo far prepar'd as to be fit for the Expreſſion of their Oil, then if inſtead of preſſing them, you rub them in a ſtone Mortar, with a wooden Peſtil, adding now and then a little Water that they may be thoroughly work'd into a Paſte, they will be chang'd into a white Maſs, which the longer it is rubb'd, the more homogeneous it will be, and the fitter for this Proceſs; for the more minutely the matter is divided, and the more intimately it is mix'd, the more readily will the remaining part of the Work be effected.

2. Upon this Maſs, pour ſo much clean hot Water as will juſt ſerve to cover it, and then upon rubbing it as before, there will be generated a milky, pinguious Liquor that will ſwim at top. After the Veſſel has ſtood quiet for a little while, gently pour off this Liquor into a coarſe thin Cloth, that by this means it may be ſtrain'd into a clean Veſſel.

3. Upon the thick *Reſiduum* remaining at the bottom of the Veſſel, and in the Cloth, pour more Water, and rub as before; and you will again have a white, thick, oily Liquor, which ſtrain, and mix with the former. Add then more Water to the remainder, rub, and ſtrain as before, and ſo proceed patiently to the end. The Liquor, by this means then, will grow gradually leſs white, thinner, and not oily, but at laſt perfectly watery, nor will acquire any further Oilineſs by being rubbed ever ſo long; and then there will remain in the Mortar but a ſmall quantity of the former Matter, and that will be branny, lean, without any Juice, not diſſoluble at all in Water, even by long rubbing, but appearing almoſt intirely terreſtrial, without the leaſt quantity of Salt, or indication of any remaining Oil. Thus, then, thoſe parts of Vegetables that abound in Oil, are divided into two different kinds of Bodies, one of which will bear to be diluted with Water, the other not. And here it is particularly to be remarked, that this very Operation may be perform'd with the *Reſiduum* of the former Proceſs after the Oil has been expreſs'd, with this limitation only, that you will procure ſo much leſs of this white, thick, pinguious Liquor, as you expreſſed more Oil before. When you have got out, however, all the Oil you can by Expreſſion, you may always prepare an Emulſion from the remainder, and that in conſiderable quantity.

4. The Emulſion thus prepared, in a great many of its properties, reſembles the Chyle of Animals, produced from Vegetables by Manducation, Rumination, and the action of the Stomach, before it is mixed with the Bile in the *Duodenum*. The white Colour, ſoft Smell, ſweet Taſte, thickneſs, oilineſs, and eaſy diſpoſition to turn ſour in both of them, prove this ſufficiently. If this Liquor, too, is ſuffered to ſtand quiet for ſome time in a tall cylindrical Veſſel, it will ſpontaneouſly ſeparate into a very white, thick, and almoſt quite oily Liquor, ſwimming at top, and a thinner, clearer, bluiſh one underneath.

And in this particular it perfectly reſembles Milk, which in the ſame manner divides into a Cream, and a Skim-milk. And again, if this Emulſion is expoſed for ſome time to a warm Air, it grows ſour, and acquires a conſiderable Acrimony, but not an oily rancidneſs, which we deſcribed as proper to the expreſs'd Oil of the former Proceſs; and in this property again it agrees intirely with Milk, which grows ſour in the ſame Air, but then recedes from the nature of pure ſimple Oil degenerating in the ſame Heat. This *Phænomenon*, therefore, which is well worth taking notice of, may ſerve as a Hint to the Phyſician, that it is ſafer in acute Diſeaſes, to preſcribe this Emulſion than expreſs'd Oils. I cou'd never, however, by Coagulation, procure Cheeſe from this Liquor, as one may from common Milk: And hence there is this difference betwixt the natural Milk of Animals, and this artificial one of Vegetables. The reaſon now that the Emulſion of this Proceſs differs from the Oil of the preceding, ſeems to be this, that the particles of the Bran are by continual rubbing very minutely divided, and diſperſed through the pure Oil, by which means they ſo attenuate its particles, and ſeparate them from one another, that they loſe their oily tenacity, and ſuffer themſelves to be mix'd with Water, and then appear in form of a Milk, conſiſting of Oil diluted in Water; whereas, when the pure Oil is expreſs'd by itſelf, the Particles cohere in ſuch a manner with one another, that they won't admit any Water between them, and conſequently will not be mix'd with it. And then again, the large quantity of Bran that is diſtributed amongſt the Oil, in making the Emulſion, is the occaſion that it won't afterwards grow rancid, but will turn ſour. Hence, therefore, we ſee, why this Liquor appears white; for this is always the caſe when Oils are ſo minutely divided, as to lie concealed in Water. This you may ſee evidently by taking ſome Water in a glaſs Veſſel, and pouring ſome Oil upon it; for then, tho' both Liquors will be diſtinctly clear, yet if you ſhake them briſkly together, they will be mixed for ſome time, and ſo long the whole will appear white; tho' upon ſtanding quiet again, the Oil will diſengage itſelf, and riſe to the top, and the whiteneſs will immediately vaniſh. And this is the caſe in common Milk, oily diſtill'd Waters, and theſe Emulſions. Nay, and it is farther certain, that the more Oil there is, the whiter the Mixture will appear, and the more it will be inclined to grow rancid; and that on the contrary, the leſs Oil there is, the leſs white it will be, and it will be more diſpoſed to turn ſour. In the Summer time, now, theſe Emulſions will ſcarce keep above ten Hours; but in the Winter they'll be good longer. This method of making Emulſions, then, teaches us what is properly the effect of Manducation in the human Body. For any Corn food that is full of a latent Oil, being moiſten'd with the *Saliva*, and work'd upon the rough, broad ſurface of the *Dentes Molares*, or Grinders, yields a Liquor that comes near to theſe Emulſions, and the more ſo, the longer it is chewed, and which at laſt is always white, when the *Saliva*, Salt, and Oil, come to be thoroughly mixed together. And then this work, which is thus begun in the Mouth, is farther promoted in the Stomach, and carried to greater perfection in the Inteſtines, the Liquor ſtill retaining its original diſpoſition, except that by the conſtant affuſion of the Animal Juices to it, it is more and more aſſimilated to the animal Nature, whereas in artificial Emulſions, we have nothing but the aſſiſtance of Water. Hence then we ſee the proper diſtinction betwixt the firſt Chyle, and the Milk of Animals.

PROCESS XXII.

Native Oils of Vegetables procured from them, by ſimply boiling them in Water.

APPARATUS.

1. WHEN Plants, or thoſe parts of them that are moſt oily, are by Expreſſion, according to Proceſs 20, deprived of all the Oil that you can in that manner ſeparate from them, let them be ſew'd up in a linnen Bag, and be kept for ſome time in boiling Water, and then part of the remaining Oil will be diſſolv'd and ſwim at top. Let this be taken carefully off with a thin Spoon, and be put by itſelf, and repeat this ſo long as any pinguious Scum ariſes. By this means then, you will have all the Oil that remained after the Expreſſion, as you had in the preceding Proceſs, in the Emulſion. The Water too in this caſe, by its milky Colour, oilineſs, and thickneſs, demonſtrates that it contains a good deal of Oil.

2. But if you take the Subſtances, prepar'd for the Expreſſion of their Oil, according to Proceſs 20, before their Oil is expreſs'd, and boil them in Water in the manner juſt deſcribed, and continually take off their Oil, you will by this means be able to collect a very large quantity of it. A pound of the beſt Cacao-nuts being pounded and boiled with eight pints of Water to the thickneſs of a pulſe, and the Fat being taken off, and collected together, yielded ſeven ounces of ſuch an Oil, which when it came to be cold, was almoſt of the conſiſtence of Tallow, as we learn from an Experiment of *Monſieur Homberg*'s, mention'd by *Du Hamel, Hiſt. de l'Ac. Roy. des Sc.* p. 371. *An.* 1701. And even then, if you take what remains after the boiling, and dry it, pound it, and preſs it, it generally affords ſome more Oil. Hence then we ſee, what a ſurprizing quantity of Oil is actually contained in Seeds.

3. In the mean time, however, there are ſome Seeds that are leaner, and by Expreſſion, or Coction, with Water, yield ſcarcely any Oil; ſuch, for inſtance, as Beans, Lentils, Peaſe, and the like. But even theſe, if, they are gently roaſted when they are dry, will both ways give out ſomething of an Oil; and the Oil that is then procured from them by boiling, will retain a good deal of the nature of the Seeds, without any conſiderable alteration.

USE.

1. THESE three Operations then being rightly performed, carefully compared together, and duly conſidered, teach us in the firſt place of what kind that Oil is, which naturally exiſts in Vegetables. And hence we ſee likewiſe the origin of that Fat which is found in Animals that live upon Vegetables; for in theſe there is always an Oil, which by Manducation, Rumination, and the action of the chylopoietic Organs is extracted from them.

2. From what has been obſerved, we ſufficiently diſcover the nature of that Oil, and its uſe in Plants.

3. And we learn, likewiſe, in what manner from Oil and Water mix'd and combin'd together by a certain Law, may be prepared a Liquor very much reſembling Chyle and Milk; and thus we ſee the method which Nature makes uſe of to produce Chyle and Milk in the human Body.

4. We ſhall now, therefore, be prepared for the Examination of the Oils called Eſſential Oils, which we ſhall treat of in the following Proceſs.

5. Phyſicians who are acquainted with theſe things, won't be ſurprized to ſee Perſons grow ſo fat, that are well, and uſe no exerciſe, even tho' they live chiefly upon Vegetables that diſcover in them nothing pinguious, ſince by Expreſſion and Emulſion it is eaſy to procure from them a great deal of Oil. When theſe therefore are ſufficiently chewed and mixed with the animal Juices, they yield an oily Emulſion, whence is prepared a Chyle, and a Milk, which depoſites an Oil into the *Folliculi adipoſi* that are joined to the Arteries.

6. And hence at the ſame time we ſee the origin of the Chyle and Milk of Animals.

7. As likewiſe the nature of thoſe Elements which make up the Compoſition of the Chyle and Milk, *viz.* ſome of the animal Juices, as the *Saliva*, and the fine exhaling arterial Vapour and *Mucus* of the Mouth, *Fauces*, *OEſophagus*, Stomach and Inteſtines on the one part; and the aqueous, ſaponaceous, oily, and ſpirituous Particles, that, by the action of Manducation, Deglutition, Digeſtion of the Stomach, and periſtaltic motion of the Guts, can be reduced into the form of an Emulſion, and ſeparated from the groſſer parts of our Food, on the other.

8. Who, therefore, from theſe Principles, don't ſee the true phyſical reaſon, why the Milk of Animals, generated from vegetable Food, and that of an aceſcent nature too, ſhou'd, when it is out of the Body, be ſo diſpoſed to turn ſour. Freſh green Graſs, certainly, if it is chew'd for a good while with the *Saliva*, begins, in the Mouth, to put on the appearance of Milk, and diſcover the ſeparation of its Oil. Hence the human *Species* will grow fat with only Bread and Water; Brutes with Water and Graſs.

9. Having rightly underſtood theſe things, therefore, don't let us give any credit to thoſe Perſons, who pretend, by their Art, to procure more Oil from any Vegetable, than what naturally exiſts in it; for we do not artificially generate Oils, but only extract thoſe that pre-exiſted before.

10. And laſtly, let me caution you not to look upon theſe Oils procured by Expreſſion, Emulſion, and Coction, as pure, ſimple Liquors; for when they come to be examined by Diſtillation, in the manner to be hereafter deſcribed, they are reſolv'd into a large quantity of Water, Soot, a true eſſential Oil, and Earth; as that very accurate Chemiſt, Dr. *Slare*, long ago obſerved, *Phil. Tranſ. Abr.* Vol. III. p. 361. And hence it ſeems to come to paſs, that the Oils prepared in all theſe three ways, will ſo eaſily change if they are expoſed to the Air, as they conſiſt of ſo many, and ſuch different principles. In Oil too procured by Coction, there is contained ſome Salt; but more in the Water it is boil'd in.

PROCESS XXIII.

Diſtill'd vegetable Oils per Veſicam, *commonly call'd eſſential Oils: An inſtance in the Leaves, or green Tops of Savine.*

APPARATUS.

1. ALL Vegetables whatever, are more or leſs fit for this Operation. Thoſe, however, are particularly ſo, in which there is a remarkable aromatic Vertue, which we deſcribed under the Proceſs 1, 15, 16, 17. But of theſe again, thoſe are the moſt elegible for this purpoſe, that diſtinguiſh themſelves by a fragrant Smell, and a pungent, warm, grateful Taſte. In this firſt Proceſs, now, upon theſe Oils, we ſhall treat particularly of the Leaves that are fitteſt for Diſtillation. And theſe are procured either from the Ever-greens, or thoſe Vegetables that naturally caſt their Leaves.

2. The Leaves of the Ever-greens, as the Fir, *Arbor Vitæ*, Orange, Box, Cedar, Citron, Ivy, Juniper, Bay, Lemon, *Marum Syriacum*, Myrtle, Pine, Wild-Thyme, Roſemary, Savine, Sage, and Thyme, are always full of Oil, but principally in the Autumn, and towards the Winter. The directions about theſe, therefore, and the method of treating them, is nearly the ſame.

3. But the annual aromatic Leaves, which naturally wither and drop, but when they are green, have a rich ſpicy Smell, muſt be gather'd when they are come to full maturity, and are juſt beginning to have their vigour abated; for then the watery Humour, and acidiſh Salt being diſſipated, there is left a more tenaceous, oily, balſamic Liquid behind. The chief of theſe Plants, now, you have in the Catalogue annex'd to the firſt Proceſs.

4. And by Experiment it has appeared, that theſe Leaves gathered at the time mentioned, have yielded more Oil in Diſtillation, when they have been gently dried in the ſhade, with a moderate Wind, than when they were immediately diſtilled, whilſt their watery Juice ſtill remain'd in them. Does this happen, now, becauſe the Oils, when the Water is diſſipated, are more cloſely united, and ſo come out in their proper form, whereas when they are divided by the interpoſition of the aqueous Particles, they impregnate the Water indeed with their vertues, but don't appear as Oils? You muſt take a great deal of care, however, that they are not dried in too great a Heat, leſt the oily parts ſhou'd fly off likewiſe. There are ſome Leaves, in the mean time, which contain ſo large a quantity of a balſamic Oil, that they will yield a great deal of Oil in diſtillation, tho' they are made uſe of green; as we ſee evidently in Roſemary, and Mint. And there are others again, which are very difficult to dry without their loſing that noble Spirit, which gives the Oil its whole excellence; of which ſort are Agrimony, Calamint, and others: There are always ſome Exceptions, therefore, to theſe general Rules.

5. With the green Leaves, then, that naturally diffuſe a fragrant Smell without being bruiſed, let your Still be filled two thirds full, and pour upon them the diſtill'd Water of the ſame Plant, and then you may begin your Operation as ſoon as you pleaſe. Thus Southernwood, Agrimony, Dill, Calamint, Scurvey-graſs, Dittany, Fennel, Lovage, Marjoram, *Marum Syriacum*, Mint,

Origany, Savine, Sage, Savory, Wild-Thyme, Tanſy, Thyme, and the *Arbor Vitæ*, yield their Oils very readily. Others, however, require a long digeſtion and maceration with Sea-Salt, or rather Spirit of Vitriol, in a very cloſe Veſſel, by which means they will be diſpoſed to give out their Oil in greater abundance. Thus if you want to draw a large quantity of the fineſt Oil from the Leaves of Fir, the Orange, Box, Cedar, Sweet-cane, Camomile, the Citron, Hyſſop, Juniper, Bay, the Lemon, Myrtle, or Pine, take any of theſe, and after you have gently dried them, put them into the Still in the manner above deſcribed, pour their diſtill'd Waters upon them to the ſame height, adding to every pint, half an ounce of Sea-Salt, or a drachm of Oil of Vitriol, and then leave them very cloſe ſtopt for the ſpace of three Weeks in a Heat of 90 degrees, before you begin your Diſtillation. And here, the more tenaciouſly any Leaves retain their Oil, the more Acid is neceſſary, and the longer Maceration; for that Acids diſengage theſe Oils, nay, and perhaps, in ſome meaſure increaſe them, *Boyle*, *Hoffman*, *Homberg*, *Le Mort*, and others, have long ago obſerv'd.

6. Proceed then to diſtill in the manner which I ſufficiently deſcrib'd, Proceſs 15; but with this circumſtance, that you muſt make the contents boil as faſt as you can, and ſo carry on the Diſtillation briſkly; for by this means, the Oil you are ſeeking for will preſently aſcend with the firſt Water, whereas if the Diſtillation proceeds ſlowly, the Oil being diſſolved and ſeparated by the great Heat, but at the ſame time not being carried up, will be agitated among the Leaves and Water, and by this means be divided and attenuated, and hence will wonderfully impregnate the Water, but of conſequence will riſe in leſs quantity. And the Diſtillation, with this degree of Fire, muſt be continued ſo long as the diſtill'd Water carries up any Oil along with it, for which reaſon you muſt often change your Receiver, to ſee if you have ſtill got any Oil; and when this ceaſes to come off, you may proceed, as long as the Water that diſtills poſſeſſes any valuable vertues of the Plant, according to Proceſs 15, 16, for that will ſerve again for preparing freſh Oil.

7. In this Operation, therefore, the Pellicles of the little Repoſitories that contain the Oil being ſoften'd by the Maceration, are burſt by the included Oil, when it comes to be diſſolv'd, agitated, and rarefied by the Heat and Action of the boiling Water, and now therefore runs out, and is thrown up to the ſurface of the Water, eſpecially in *European* Vegetables; and the oily Particles being afterwards raiſed with thoſe of the Water, are carried into the Worm where they are condenſed into their proper form, and ſo diſtill into the Receiver, pure, nearly in their natural ſtate, and without any empyreumatical Taint, ſtrongly retaining the Taſte, Smell, and peculiar Qualities of the Plants they are drawn from, and efficaciouſly containing them in a very ſmall compaſs. And when the Oil is thus ſeparated from any Vegetable by Diſtillation, the *Reſiduum* is found to be abſolutely deprived of it all, and then retains ſcarcely any marks of its proper nature. Thus the Oils of Wormwood, Box, and Calamint, diſtinguiſh themſelves perfectly by the ſame Scent and Taſte as the Vegetables do; but when theſe are quite drawn off, the remainders can hardly be known from one another. Theſe Oils too may be kept for a conſiderable time without growing rancid. From the conſideration, therefore, of all theſe properties, the Chemiſts have diſtinguiſhed theſe Oils by the name of Eſſential Oils.

USE.

1. THESE Oils have a pretty conſiderable acrid quality, which heats, inflames, ſtimulates the Nerves, and attenuates cold pituitous Viſcidities, but which at the ſame time is grateful to the Smell and Taſte, and raiſes the Spirits. Their Acrimony they diſcover by being applied to the Membranes and Nerves when they lie bare in Wounds, for then they excite a very acute pain. Their power of heating we learn from the actual Heat they raiſe when uſed internally, which is greater than that produced by almoſt any other ſimple Bodies; ſo that the too liberal uſe of them will bring on and keep up an imflammatory Fever, and if it is perſiſted in, will heighten it to the utmoſt degree of Heat and Violence: And if they are applied externally to the Skin of a Perſon in Health, and are well ſecured that they can't be driven outwards, they excite a leſs, and then a greater degree of Heat, with pain, redneſs, a ſhining tenſion of the part, and pulſation, and ſeparate the Cuticle into a Bliſter, and if kept on, will produce at laſt even a Gangrene itſelf. Hence, then, Phyſicians may infer, how powerfully theſe Oils act by this inflammatory quality, when they are imprudently taken inwardly, where being applied to the Membranes of the *Viſcera*, they excite ſuch topical inflammations. But on the ſame principles, when they are rendered active in the Body by the vital Powers, they ſtimulate the Nerves moſt efficaciouſly. Hence, therefore, when there are any Viſcidities in the Body ariſing from mere inactivity, and that wou'd be diſſolv'd by a greater degree of motion, they wonderfully attenuate, and diſcuſs them. By the fragrance of their Smell too, and the agreeableneſs of their Taſte, they prove a very grateful relief to the languid Spirits. In all theſe caſes, however, theſe Oils don't operate ſo much by their oily tenacity, as by the aſſiſtance of thoſe ſubtil Spirits, which being inviſcated, and retained in them, give every Plant its particular and diſtinguiſhing Smell and Taſte; but of this we have treated already, in Proceſs 1, 15, 16, 17. Theſe Oils, therefore, when they are prudently managed, yield a moſt noble medicine, in all thoſe Diſeaſes where the animal, natural, or vital Spirits are either deficient or inactive. Hence in cold watery habits of Body, where there is a ſimple *Leucophlegmatia*, or in a mucous *Pituita*, ariſing from a mere *Inertia* of the Solids, without any inflammatory Obſtructions, they are of excellent ſervice; as they are likewiſe in perfect, cold, Winter intermittents, if they are taken betwixt the Fits, particularly when the cold Fit is juſt coming on. Perſons in years too, from a moderate uſe of theſe Oils, find a conſiderable advantage. Nor to thoſe Hypochondriacs, who have ſuch a *Lentor* in their Blood, that it is ſcarcely fit for the production of Spirits, and who hence are ſo inactive, dull, forgetful, and lethargic, and upon every little occaſion are ready to weep like Children, are they leſs beneficial. And thoſe of the other Sex too, who are troubled with hyſterical Diſorders from the ſame cauſe, are relieved by theſe Oils likewiſe: But let me caution you at the ſame time, that thoſe who are diſordered in this manner from a fulneſs of Blood which ought to be diſcharged, and hence have their Veſſels quite choak'd up, are vaſtly the worſe for ſuch kind of Medicines. And ſo in Apoplectic caſes, ariſing from a lethargic diſpoſition in Perſons in years, and where there is a *Torpor* for want of Spirits, theſe Oils do Service;

whereas in thoſe that are cauſed by an extravaſation of Blood within the Skull, an inflammatory obſtruction, or a diſtenſion of the Veſſels from a *Plethora*, they are almoſt fatal: And hence, to theſe laſt, the apoplectic Balſams made of theſe Oils, prove ſo often prejudicial, tho' they are every where ſo mightily cried up without diſtinction. But in no caſes are theſe Oils more extoll'd, than in colicky Pains, the iliac Paſſion, and where the Stomach is troubled with Wind: There is need of ſome prudence however in the adminiſtration; for as theſe diſorders may ariſe from an Inflammation, plethoric ſpaſms, and the like, theſe Oils may here prove very hurtful, tho' when they are owing merely to a cold habit of Body, a ſlow circulation of the Blood, and a cold viſcid *Mucus* in the firſt paſſages, they prove a beautiful Medicine.

2. In a chemical view, now, from what has been ſaid, it is evident, 1. That in aromatic Plants, there is an Oil, which becomes volatile in the heat of boiling Water. 2. That in this Oil reſides chiefly their proper Spirit, which riſes with it in diſtillation, and will afterwards remain united with it for a great many years, if it is but well ſecured in a cloſe Veſſel. 3. And that this Oil exiſts in Vegetables, but in a certain quantity, which being drawn from them, there is not the leaſt portion remaining. 4. If the Water, however, which you add in the diſtillation of Vegetables, is ſaturated with as much Salt as it will take up, then, when it comes to boil, it will have a greater degree of Heat in it than ſimple Water has in the ſame circumſtance, as was formerly demonſtrated in our Theory; and hence by an addition of Salt there will be more of the vegetable Oil diſſolved than there wou'd be without it. You will be miſtaken, however, if you imagine you ſhall by this means obtain more of that noble ſpirit which gives the Oil its whole value, for this will certainly be ſeparated with the heat of ſimple boiling Water. 5. But hence we learn farther, that theſe Oils of Vegetables are more volatile than that ſaline Matter, which, with a ſtronger Fire, riſes in form of a volatile, oily, acid, or alcaline Salt, or than that which by an open Fire is converted into a fixed Alcali. 6. And again, we here obſerve, that the peculiar Vertues proper to particular Plants, are found to be more efficaciouſly contained in theſe Oils, than in any of the other ſimple parts; though this indeed depends intirely upon the *Spiritus Rector* that reſides in them. Neither the Water, the more fixed Oil, the *Sapo*, nor even the Salt itſelf of a Plant poſſeſſes its peculiar properties; nor will any perſon, by the examination of theſe ſeparately, be able to diſcover what Plant they were procured from; it is this Oil alone, which by its Smell and Taſte will certainly diſtinguiſh them from one another. Or if the Oils drawn from two different Vegetables are found to be very much alike, then theſe generally obtain the ſame name, as we ſee in the Oil of Roſes, and the *Lignum Rhodii*, which is therefore called Roſe-wood. And thus the affinity betwixt the Oils of the *Caſſia Lignea*, and the Bark of Cinnamon, has occaſioned the true Cinnamon Tree's being called the *Caſſia Lignea*, the other the *Caſſia Fiſtula*. 7. And hence we ſee laſtly, how great, and how excellent a part of Vegetables is loſt in boiling.

PROCESS XXIV.

Diſtill'd Oils from dry Leaves per Veſicam: *An inſtance here in Mint.*

APPARATUS.

1. WE muſt now perform the ſame Operation upon Herbs that are dried. The Herb Mint, therefore, gathered at a proper time, dried in the Shade, and then kept ſix Months, I digeſt with its own diſtill'd Water, and diſtill as in the preceding Proceſs: But here it is neceſſary to obſerve, not to fill the Still above half full with the dry Herbs, becauſe when you pour the Water upon them, they'll ſwell a good deal, and ſo be apt to burn, and riſe into the Head. From the beginning then of the Diſtillation to the end, you will have an Oil in conſiderable quantity, that will ſwim upon the diſtill'd Water, and remarkably diſtinguiſh itſelf by its Smell, Taſte, and Vertues.

2. If, when the Operation is over, you take the *Reſiduum*, preſs out all the Juice, and put this upon freſh dry Mint, and after you have carefully ſeparated all the Oil, add the former diſtill'd Water, and as much more of the ſame as is neceſſary for the Diſtillation, and then digeſt and diſtill as before, you will by this means have more Oil in this ſecond Diſtillation than you had in the former. And if you repeat this Operation ſome number of times, you will conſtantly have more and more Oil, for the Water itſelf, being often cohobated, at laſt becomes oily, and gives out an Oil plentifully. Hence we eaſily ſee, that theſe Waters muſt acquire the proper Vertues of the Plants they are drawn from, as we ſufficiently explained formerly in Proceſs 10. The uſe of the Oil, too, we treated of particularly in the former Proceſs; and hence what is ſaid there may be applied to this Oil prepared by cohobation.

PROCESS XXV.

Diſtill'd Oils from Flowers; here from thoſe of Lavender.

APPARATUS.

1. THE fragrant Smell of Plants ſometimes reſides in their Flowers alone, at others, in them particularly. But as this is exceeding grateful, ſo it generally eaſily flies off and is but of ſhort continuance, on account of the curious and tender fabrick of the Flowers; though there are Flowers, it's true, that retain their proper fragrance for a conſiderable time, as is evident in thoſe of Lavender. The method of procuring their Oil from them, however, is in almoſt all of them the very ſame. Theſe then muſt be gathered at the time when they are moſt ſcented, which is commonly when they are juſt ready to open their Leaves, and they muſt be cropp'd whole, whilſt the morning dew is upon them. They muſt then be put immediately into a Still to the height of two thirds, and as much Water, drawn from the ſame ſort of Flowers by a former diſtillation, muſt be poured on as is ſufficient for your Purpoſe, to which add ſo much Oil of Vitriol as will make it gratefully acid. Then proceed to diſtill in the

manner which has already been ſufficiently deſcrib'd, and by this means you will procure ſome Oil, that will ſwim upon the Water, and muſt be ſeparated and kept by itſelf. Take the Juice expreſs'd from the *Reſiduum* of this Operation, and put it, with the diſtill'd Water drawn off, and as much more as is neceſſary, upon more Flowers, and add a ſmall matter of Oil of Vitriol, and diſtill again; and you then will have a greater quantity of Oil. And upon a repetition of the ſame Operation, you will conſtantly be able to procure every time more and more, repeat it as often as you pleaſe; for as the Juice that is preſſed out of the *Reſiduum* grows thicker, and the cohobated Water ſtronger, the Oil will always riſe in greater abundance, if you do but carefully ſeparate it from the Water after every diſtillation. And the Waters, likewiſe, thus made uſe of, at laſt like the Oils, become exceedingly fragrant, and acquire excellent medicinal Vertues.

2. As this Oil is remarkable for its incomparable fragrance, and hence is very valuable, ſo the quantity of it that can by this means be procured is but very ſmall. For this Reaſon therefore, the Artiſts have uſed their utmoſt endeavours to find out ſome method to obtain it in greater plenty, and at laſt it was diſcovered, that Flowers digeſted in cloſe Veſſels for the ſpace of fifteen days, or longer, with a little Oil of Vitriol added to keep 'em from putrifying, yielded a third part more of this beſt Oil, of which you have an inſtance in the choice Oil of Roſes, mentioned in the *Mem. de l'Ac. Roy. des Sc.* Vol. II. p. 208. The Flowers of Agrimony, garden Cloves, Camomile, the Citron, Jeſſamy, Lavender, White Lilies, Lilies of the Valley, the Lemon, the *Philadelphus* of *Athenæus*, Roſes, Tanſy, and the Tuberous Hyacinth, are the chief that are made uſe of for this Operation.

USE.

THESE Oils, on account of their delightful Smell, are very much eſteemed by Perſons of figure, and therefore it is worth while to take ſome Pains about them.

PROCESS XXVI.

Diſtill'd Oils from Seeds: An Inſtance here in Fennel-Seed.

APPARATUS.

1. IT has long appear'd, that the Oil of Plants reſides in great plenty in the Cotelydones of their Seeds, and hence, from theſe, the aromatic ones in particular, it is frequently prepared. And here it is obſerved, that the hotter, more biting, and ſcented theſe Seeds are, the greater quantity, and the more valuable Oil they yield. In this affair, however, we find Nature don't always follow the ſame Law: For ſometimes the Seeds alone contain the aromatic Balſam of the Plant, as we ſee evidently in Aniſe, Cummin, and many more; whilſt at others it has plac'd the Oil in ſome other part of the Plant, and none of it at all in the Seeds, as in the Roſe, for inſtance, which has a beautiful Oil in its Flower, but nothing of it in its Seed or Fruit. And

thus too the Flowers and Leaves of the Orange, and the Peel of the Fruit, yield a fragrant Balſam, of which, in the Seeds, there is not the leaſt appearance: There is, it's true, in theſe Seeds an Oil likewiſe; but not that fine one which is in the other parts. Nor do the Seeds of the fragrant *Ceylon* Cinnamon yield any of that choice Oil, which is contained in ſuch abundance, in the Bark, Wood and Leaves. Hence, therefore, in this caſe, we can lay down no general Rule, but we muſt here again have recourſe to particular Experiments if we wou'd come at the truth. The Seeds chiefly eſteemed for this Operation are thoſe of Garlic, Marjoram, *Amomum*, Dill, Angelica, Aniſe, Smallage, Onions, both Cardamoms, Baſtard Saffron, Scurvygraſs, Coriander, Cubebs, Cummin, Rockets, Flixweed, Fennel, Maſterwort, Juniper, Bay, Lovage, Spignel, Sweet Cecily, Mountain-Smallage, Origany, Pepper, Rue, Muſtard, Tanſy, and Zedoary.

2. Theſe Seeds muſt be gathered when they are perfectly ripe, and be dried for the Space of three Weeks, in a place where the Wind blows thro': Then digeſt them for three Days in a cloſe Veſſel with hot ſalt Water, and diſtill according to the Rules we laid down in the Diſtillation of Waters, unleſs that you muſt make them boil more ſtrongly, as otherwiſe the Oil will not be ſo well ſeparated, nor riſe ſo eaſily. And here again a Brine being made uſe of inſtead of Water, communicates a greater degree of Heat to the Seeds, and ſo makes them give out their Oil more readily, and more pure in Diſtillation.

3. But here let me caution you, that ſome Seeds contain ſo great a quantity of Oil, that it collects together in the Worm, in the Refrigeratory, and when it comes to a part that is cold, hardens into a ſolid Maſs, and ſo intirely ſtops up the Worm: By this means, then, as nothing can any longer deſcend, the Vapour of the boiling Water, and the Oil is confined, and being greatly rarefied, throws off the Head of the Still, and burſts forth with a great heat and violence, very dangerous to any body near it. It's abſolutely neceſſary, therefore, to take care, that the Worm made uſe of for theſe diſtillations, is not too narrow, nor grows too cold, which is beſt provided againſt by not having it too long. And if ever, during the Diſtillation, you obſerve, that the Water and Oil does not come off, you muſt, without any delay, carefully take off the Head, and pour ſome boiling Water into the Worm, that the Oil may by that means be melted, and run through, and then you may proceed again with your Operation. The Seeds that are moſt liable to this inconvenience are thoſe of Aniſe, Cardamoms, Baſtard Saffron, Fennel, Bay, and Zedoary. Theſe Oils, in nature, nearly approach to Camphire, which melts with a diſtilling Heat, but hardens again immediately when it comes to be cold; and here we may obſerve, that what thus ſtops up the Worm is pure Oil. In very hot Countries, the Aromatics are concocted to that degree by the heat of the Sun, as to have their Oils thus converted into Camphire.

USE.

HENCE then we ſee, that in the Lobes of the Seeds of ſome Plants Nature has diſpoſed a large quantity of an Oil, that is ſtrongly impregnated with their proper diſtinguiſhing Spirits, to the end that within theſe the tender Embryo may be ſafely lodged, and lie ſecure till the proper ſeaſon for its appearance is come about. And hence again we learn, that the vital Principle, when it is encompaſs'd with ſuch a Balſam, may be preſerved a conſiderable time, and indeed, that ſuch a ſecurity is neceſſary, that on one hand it may not be deſtroyed by the Winter's Cold, nor, on the other, by an unſeaſonable Warmth and Moiſture, be brought forth immaturely, and periſh. And for this reaſon, in the Root and the Seeds particularly, we find this Oil. But as there are a great number of Seeds, now, whoſe diſtill'd Oil have no remarkable Smell or Taſte, hence we are certain, that the Spirits of many Vegetables eſcape the notice of our Senſes, though at the ſame time they give them all their peculiar properties, and ſo, accurately diſtinguiſh them from one another. To the ſagacity of our Senſes, therefore, though we may attribute a good deal, yet we muſt take care we do not aſcribe too much. Perhaps, now, the more volatile the Spirit is that is contained in the Oil of the Seed, and the warmer Taſte it diſcovers, ſo much the leſs time will ſuch Seeds retain their prolific Vertue; whilſt on the other hand thoſe that poſſeſs one naturally leſs active, may be diſpoſed for a long time to propagate their *Species*. Certainly the moſt fragrant aromatic Seeds, and thoſe which diſtinguiſh themſelves by the moſt biting Taſte, ſoon become effete and incapable of producing new Plants. This we ſee plainly in the umbelliferous, balſamic Plants, and in the fine, aromatic, *Indian* Seeds, which are almoſt always ſpoil'd in this reſpect by that time they are brought to us, witneſs the Cardamons, Cubebs, Zedoary, and Ginger; whereas, on the other hand, thoſe of the Thorn-tree, Senſible Plant, *Caſſia*, *Senna*, and Tamarinds, may be kept a great while. The ſame thing we ſee likewiſe in the different Corn-ſeeds, which, after a great length of time, will diſcloſe a fruitful Embryo. But in this Affair it is particularly remarkable, that the Oil of theſe Seeds, ſo long as they are kept dry, will retain its proper qualities intire a long while, and by a chemical management may, in form of a true Oil, be extracted from them; whereas, if they come to be moiſtened with warm Water, and begin to germinate, the quantity of Oil is immediately diminiſhed, and they begin to be more diſpoſed for the production of Spirits. Hence therefore, perhaps, it is not improbable that this ſeminal Oil may, by the prolific moiſture of the Earth, the action of the Air, and ſaponacious quality of the Juices of the Soil, and Seed, be diſſolved, attenuated, rendered miſcible with Water, and inſinuate itſelf into the Canals of the little Root, implanted in the Cotelydones, and ſo be propell'd through the Veſſels of the Embryo, cheriſh the tender Plant with its Spirits, imbrue its nutritious Juices with a particular quality, and impreſs upon them the Character of the Plant that produced it: Certainly, when Seeds have once been moiſtened ſo as to give ſigns of a vital motion, if they are kept afterwards, they won't be fit for raiſing new Plants.

PROCESS XXVII.

An Oil, diſtill'd from the Hypocarpia, *called* Clavi *of the aromatic* Moluccan *Cloves.*

APPARATUS.

1. THIS wonderful *Species* of *Indian* Aromatics, both the greater, which bears its Seed almoſt at the top of its Branches, and the leſs, which has no Seed at all, abounds ſo plentifully with a very biting, balſamic Oil, that, if you warm them, and preſs them only with your Finger, or wound them with a needle, an Oil will ſpontaneouſly ooze out, which for its Scent, and cauſtic Acrimony has ſcarcely its equal. And, indeed, if theſe are examined, when they are juſt imported from the *Indies*, and are taken freſh out of the middle of a Bag, it is hardly credible how much Oil they will yield; certainly you can ſcarce procure ſo much aromatic Oil from any other Body whatever. Let theſe, then, choſen at ſuch a time, be put whole into twelve times their weight of Water, and immediately diſtill them pretty ſtrongly with a Worm, and you will have a milky, thick, turbid Water, and with this there will come off a large quantity of Oil of a golden colour, which will ſubſide, and be collected at the bottom of the Water. When you have in this manner drawn off two thirds of the Water you made uſe of, change the Receiver, and upon the *Reſiduum* pour as much freſh Water as is come off, and then proceed to diſtill as before; and by this means you will again have a Water impregnated with the Vertues of the Cloves. And if you go on to repeat this Operation, you can hardly believe how long the Water will be ſomewhat aromatic; at laſt, however, after a tedious repetition, you will have a Water that is acid, cold, and ſcarcely odorous. Save, then, all the ſcented Waters, and they'll ſerve another time for the diſtillation of the Oil inſtead of ſimple Water. After the Operation is compleated, there will remain at the bottom of the Still a brown, thick, inodorous Liquid, of an acid-auſtere Taſte, in which one can diſcover no indication at all of the original qualities of the Cloves. The Bodies of the Cloves, indeed, after the Diſtillation, retain ſo exactly their proper form and colour, that, when they are half dried, a Perſon that is not aware of it may take them for true neat Cloves. And indeed, if they are afterwards mixed with freſh Cloves that are very oily, they will be again impregnated with an aromatic Smell and Taſte, and will in ſuch a manner attract the Oil out of the others, that you can't then diſtinguiſh them from the genuine. In this way ſome Perſons who deal in Spices, adulterate them, and baſely make an advantage of it.

2. But if you want this Oil, which always, when procured in this manner, appears ſomewhat mucilaginous, I ſay, if you want this purer and brighter the firſt time; then inſtead of Water, for the firſt Diſtillation, make uſe of a ſtrong Brine of Sea-Salt, and digeſt two or three Weeks before you diſtill: But then, however, the *Reſiduum* cannot be examined.

USE.

THIS Oil heats exceedingly, nay, is truly cauſtic. Hence in cold habits of Body, and the coldeſt Diſtempers, 'tis an incomparable medicine. Where there is a *Languor* of the Spirits, too, this proves very efficacious in raiſing them, whether taken inwardly, or applied outwardly. This wonderful Oil, however, which is impregnated with ſuch noble Spirits, if it is expoſed in an open, broad, glaſs Veſſel to a warm Air, ſoon diffuſes its Spirits, and fills the place with a fine aromatic Smell, and in a little time is converted into a thick, tenacious, inactive Oil, though in the extreme heat of the hotteſt Climates it effectually holds them down, and ſecures them for ſo long a ſpace of time. This Oil too, as it is heavier than Water, always falls to the Bottom, and whilſt it is covered with that, will retain its Vertues. This is rarely found to be the caſe in *European* Vegetables, but is frequently obſerved in the hotteſt parts of *Aſia*, *Africa*, and *America*, in the Aromatic Trees in particular, as the Clove, Cinnamon, *Guaiacum*, and Saſſafras. This Oil, however, though it is ſo heavy, is carried up by the aſſiſtance of boiling Water, and with the Vapour of that riſes in Diſtillation. And laſtly, which is pretty remarkable, Vegetables that abound with this very hot Oil, do not, when they are diſtill'd, diſcover any alcaline Salt in their *Reſiduum*, but an acid, rough, cold, and pretty fixed one, which ſerves as a *Vinculum* to hold down the Oil, which of itſelf wou'd be too volatile.

PROCESS XXVIII.

An Oil diſtill'd from Saſſafras.

APPARATUS.

1. IF light, oily, aromatic Woods, cut in the Winter ſeaſon, are raſped whilſt they are ſound and freſh, and boiled ſtrongly in a Still with twenty times their weight of Water, there will diſtill from them a milky Water, and an Oil, which from the Saſſafras of *America*, is nearly pellucid, and ſinks to the bottom of the Water, though the Wood itſelf is pretty ſoft, light, and almoſt ſpongy. Proceed in your Diſtillation as long as any Oil comes over, or the Water appears conſiderably milky; and you will have then remaining in the Still an acid-auſtere Decoction.

2. If you then take ſome more freſh Shavings, and diſtill them with this Decoction and the former Water, you will the ſecond Diſtillation have a larger quantity of Oil: And if you repeat it a third time with the cohobated Water, and twice decocted *Reſiduum*, it will by this means be farther increaſed.

3. This is the method we make uſe of to draw the Oil from all Woods that give it out eaſily; of which ſort in particular, are Fir, Pine, and Saſſafras: But here the Oil of the two firſt is light, and ſwims upon the Water, the laſt is heavy, and falls to the bottom.

4. But Woods that are very hard and heavy, muſt be raſped finer, and digeſted a good while with ſalt Water, and then be diſtill'd with a Brine of Sea-

Salt, for by this means at length their Oil may be ſeparated from them. Of this kind is the Wood of the Orange, *Arbor Vitæ*, Benjamin, Box, Cedar, Citron, Snake-tree, Guaiacum, Roſe-wood, all kinds of Juniper, the Lemon, Savine, Styrax, and the other balſamic Trees which produce the Balſam Capivi, Peru, Tolu, and Elemi: And the longer theſe are digeſted with Brine in cloſe Veſſels, the more eaſily they give out their valuable Oils in Diſtillation.

5. Thoſe Woods that are oily, reſinous, balſamic, gummy, and diſcharge a Pitch, are the propereſt for this Operation, eſpecially if they are at the ſame time heavy, and ſolid. Thoſe on the other hand which are light and ſpongy, and grow chiefly in wet places, as the Alder, Poplar, Willow, Elder, Vine, and the like, are unfit for Diſtillation, yielding ſcarcely any thing of this Oil.

6. Woods lopped at that time when the Juices are moſt in motion, yield leſs Oil, and what they do yield, is not ſo good, as you may procure from the very ſame, if they are cut in the middle of a ſharp Winter. The Wood likewiſe of young Trees that grows apace, gives out leſs Oil than the ſame does when they have been a good while paſt their maturity, and are grown old. And laſtly, the Ever-greens yield more, and a hotter Oil than thoſe which naturally ſhed their Leaves. From theſe Obſervations, then, it is evident, why heavy Oak is choſen for building, and qualified too in the manner we have mentioned.

7. From what has been ſaid then, we learn, that the weight of Woods is owing chiefly to a heavy compact Oil, cloſely connecting and binding together the other Principles; not this only which riſes in Diſtillation, but that particularly which remains in them when the Operation is over: This, Cedar, Guaiacum, and Juniper, ſeem to evince. And their diſpoſition to laſt a great while, depends likewiſe upon the ſame cauſe; whence we ſee that the moſt durable Woods are always the moſt oily, witneſs the Box, Cedar, Olive, and Oak. And laſtly, it is their Oil in particular that gives them their exceſſive hardneſs; for the ſoft, fungous, ſpongy Woods are without it; the Box, Snake-tree, Guaiacum, Olive, and Iron-wood, abound with it. Hence then we have a notion of Oils, Balſam, Turpentine, Reſin, and Pitch, which have all the ſame origin, but are concocted and inſpiſſated with a greater or leſs Heat of the Sun. And hence we underſtand how Woods become carious, *viz.* by Worms feeding upon the ſubtil Oil contain'd in their little Follicles, and oily Ducts, whence they afterwards fall into a kind of Aſhes; or by their being expoſed to the alternate actions of a hot, cold, moiſt, and dry Air, by which means their Oil will be conſum'd likewiſe, and there will remain nothing but a friable Earth.

PROCESS XXIX.

An Oil diſtill'd from the Bark of Cinnamon.

APPARATUS.

1. WE formerly took notice, that in the Barks of Trees, the old ones in particular, and the Ever-greens, there is collected a great quantity of Oil, which appears there under the different forms of Oil, Balſam, Colophony,

ny, Camphire, Gum, Tears, Reſin, and Gum-Reſin, always preſenting us with the native pinguious part of the Vegetable. For this reaſon, therefore, the Chemiſts have diſtill'd theſe in the ſame manner we mentioned of the Woods, and have drawn from them large quantities of the moſt beautiful Oils. Thus I take the choiceſt freſh Cinnamon, broke into ſuch pieces as will conveniently lie in the Still, and diſtill as in the preceding Proceſs. In the firſt place, then, there comes off a white Water reſembling the beſt Milk, which elegantly contains the Smell, Taſte, and Vertues of the Cinnamon; and at the ſame time there riſes an Oil of a golden Colour, which falls to the bottom of the Water: And ſo long as this milky Liquor, together with its Oil, continues to run, ſo long you muſt keep up your Diſtillation; but as ſoon as ever, with the ſame degree of Heat, you obſerve a clear Water come off, you muſt then change your Receiver, and proceed again, by which means you will at laſt have a Water perfectly clear, and without any Oil, which you muſt carefully watch, in order to deſiſt as ſoon as ever this ceaſes to have any Smell or Taſte of the Spice. This ſecond Water muſt be ſaved by itſelf, and will have ſomewhat of the Vertues of the Cinnamon. I generally, then, put ſome freſh Water upon the *Reſiduum*, and make it boil briſkly, upon which there riſes a light, clear, thin, inodorous Water, of a cool acid Taſte, which often during the Diſtillation, corrodes the Copper head, and by this means grows greeniſh, nauſeous, emetic, of a vitriolic nature, and hence proves of ſervice againſt Worms. This however, has not the leaſt mark of Cinnamon in it, and therefore, when it has ſerved for this Experiment, it is of no farther uſe. The Operation being over, there remains in the Still a thick turbid Decoction, which is of a browniſh red Colour, has an acid auſtere Taſte, and is very aſtringent. And the Bark of the Cinnamon retains its true appearance ſo exactly, that if one does not examine it, either by ſmelling to it, or taſting of it, one may eaſily take it for the beſt freſh Cinnamon, eſpecially if it is firſt gently dried. Nay, and if this is put for ſome time into a parcel of very good Cinnamon, it will by this means acquire new Vertues, which therefore will be proportionably deſtroy'd in the other.

2. If you carefully ſeparate the two firſt Waters from their Oil, and make uſe of theſe with the remaining Decoction, to diſtill freſh Cinnamon, inſtead of common Water, you will by this means procure a good deal more Oil, and the Water that comes off firſt will be exceeding white and oily, and as grateful almoſt as the Oil itſelf. If you repeat this Operation, therefore, and always carefully ſeparate the Oil, you will at laſt have a great quantity of an exceeding choice Oil: You never, however, will be able to procure but a certain quantity both of the Oil, and medicated Water, which it is not poſſible to increaſe by any method whatſoever.

3. But as this Oil is exceeding valuable, and yet in this manner of diſtilling it, there is always ſomewhat flocculent and mucilaginous adhering to it, which both renders it impure, and hinders its being nicely ſeparated, hence the Artiſts have ſtudied how this might be prevented, and they found, that if it was digeſted with a Brine of Sea-Salt, or Water made very acid with Vitriol, as we mentioned in the Cloves, before it was diſtill'd, then the Oil that came off wou'd be purer, and capable of being more accurately procured without any admixture of heterogeneous parts. Hence, then, by cohobating with this ſaline or

acid Water, and the former diſtill'd Waters of the Cinnamon, you will prepare a moſt beautiful Oil, and a Water equal in vertue to the Oil.

4. If the ſubſtance of the Cinnamon that remains after the Operation No. 1. of this Proceſs, is burnt with an open Fire into Aſhes, it yields ſcarcely any Salt, nay, I may almoſt ſay, none at all. But if the Decoction deſcribed No. 2. is inſpiſſated, it produces a very rough extract, which being burnt according to Proceſs 5, affords a little Salt, in which there remains nothing at all of the proper vertues of the Cinnamon. It is to no purpoſe, therefore, to prepare, with ſo much labour, this very ſmall quantity of Salt, in order to mix it with its Oil, to make that coſtly Eſſential Salt, as it is called, of Cinnamon.

USE.

THE Bark of Fir, Guaiacum, Juniper, Pine, Savine and Saſſafras, are the principal that are made uſe of for this Operation. From Caſſia, digeſted for a great while, you may procure ſomething of the ſame nature. From what has been ſaid then, we learn how vain the boaſts of thoſe trifling Chemiſts are, who pretend, by a ſecret Art of their own, to draw from this valuable and coſtly Spice Cinnamon, twice or three times as much genuine Oil as other People can; for it is prepared only by nature in a certain meaſure, which may be eaſily ſeparated by the common method juſt deſcribed, and beyond which Art cannot produce the leaſt drop more. In this Oil now, there is contained a perfectly igneous Spirit, which like true Fire, ſoon conſumes the human Body, and which in Acrimony is exceeded by none, as is ſufficiently confirmed by Experiments. If it is taken internally, therefore, or is applied externally, it heats, inflames, nay, and will immediately burn in ſuch a manner, as to produce a gangrenous Eſchar. In the mean time, however, with regard to its invigorating power, there is not any one thing in the whole *Materia Medica*, that can be compared with it. Certainly, if there is any Medicine that is of ſervice in cold pituitous uterine Diſorders, it is this diſtill'd Oil, when it is made uſe of by a ſkilful Phyſician. But there is one thing very remarkable in this Oil, which is confirm'd by a great many Obſervations, *viz.* that if a large quantity of it truly prepared in *Ceylon*, ſtands quiet for ſome years in a Veſſel accurately ſtopt, then great part of it will be converted into a real Salt, which will diſſolve in Water, and will be ſtrongly impregnated with the proper vertue of the Cinnamon: This I have had from various Perſons of Credit, and it is confirmed by the Obſervation of the famous Dr. *Slare*, who ſays, that in the ſpace of twenty years, half ſuch an Oil, cloſely ſecured in its Veſſel, was changed into pure Salt, *Phil. Tranſ. Abr.* Vol. III. p. 362. This now is not found to be the caſe, when the Oil is kept negligently ſtopp'd ſo that it loſes its Spirits, and hence becomes vapid and inactive, whence it ſeems to appear, that this Spirit has a power of generating Salt from its own Sulphur, which well deſerves a careful Examination.

PROCESS XXX.

Diſtill'd Oils per Deſcenſum: *An inſtance here in Cloves.*

APPARATUS.

IT being obſerv'd, that when Vegetables abounding with Oil were put in motion by Fire, they ſweated out their pinguious Fluids, which might then be eaſily collected, a method was contrived for procuring Pitch from the Wood of the coniferous Trees by uſtulation. *Axtius de Coniferis.* And this afterwards was applied to the very oily Seeds, which diſcharged an Oil in the ſame manner when it came to be fuſed by a gentle Heat, as we ſee evidently in Almonds. And laſtly, the aromatic Plants by the ſame method were made to give out their Oils likewiſe. The Oil, however, procured in this manner, differs intirely in Smell, Taſte, and Vertue, from that expreſs'd according to Proceſs 20. To let you ſee an inſtance of this then, I take ſome choice Cloves pounded till they are reduc'd to an oily Pulp. This I ſpread to the thickneſs of a quarter of an inch, upon a piece of very cloſe linnen Cloth, which is tied over a cylindrical glaſs Veſſel in ſuch a manner, that it can't poſſibly fall in: And here the deeper the Veſſel is, the fitter it is for this Operation, as the cavity underneath the Cloth being by this means ſo much the bigger, will more readily cool and condenſe the oily Vapour. I then take this iron Cover, which is a little Concave, has a flat rim, and is made of ſuch a ſize, that the Rim may reſt exactly upon that of the glaſs Veſſel, whilſt the lower Convex part goes juſt within its Cavity; and here the depth of the Cover in the middle need not be above four lines. This then I lay upon the Cloves, and preſs it down a little, that its Convex part may force down the Cloves, and cloth, a little way within the Mouth of the Glaſs. Theſe things being thus diſpoſed, I fill the hollow of the iron Cover with clear Aſhes, and upon thoſe lay a few live Coals, the Heat of which penetrating to the Cloves, agitates and diſſolves them, by which means their native Oils and Water being reſolved into Vapours, float about in the Cavity underneath, till being condenſed upon the cold ſides of the Glaſs, they run down in drops to the bottom, and there form a very hot Water and Oil. If you carefully then continue your Fire, you will be able by this means to draw out almoſt all the Oil; and when you perceive that nothing comes away with the ſame degree of Heat, then your Operation is over. But here you muſt be cautious not to increaſe your Fire too much, for fear of giving the Water and Oil an empyreumatical Taint; and yet, on the other hand, if it is too gentle, you will hardly get any thing out. The middle Heat may, however, be eaſily obtained, by beginning with a very little Fire, and then gradually increaſing it. By repeating this Operation then with freſh Cloves you may procure what quantity of Oil you pleaſe.

USE.

FROM this Experiment, we learn the natural diſpoſition of the proper aromatic Oil. And that now which is procured in this manner, diſcovers the ſame Smell, Taſte, and Vertues, as the diſtill'd eſſential Oil does, in every particular, ſo that it can ſcarcely by any means be diſtinguiſh'd from it. There is leſs Oil indeed procured from the ſame quantity of Spice by this method, than by diſtilling it with Water; but then the *Reſiduum* may be ſtill uſed for Diſtillation, and other purpoſes, for it retains a great deal of the original aromatic Vertues. This Operation is chiefly made uſe of, when one wants to prepare the Oil in a very ſhort time, or to ſhew this Experiment; otherwiſe the Diſtillation with Water is preferable. By this method, ſuch an Oil may be drawn ſpeedily from Orange, Citron, and Lemon-peel, Mace and Nutmegs, and from other Subſtances too that are very oily, when they are prepared in the manner abovementioned. Hence then we ſee what effect this degree of Fire has upon Oils, as they naturally exiſt in Vegetables, *viz.* it melts them, and ſeparates them in ſuch a manner, as to make them ſpontaneouſly, as it were, ſweat out. But when the Bodies made uſe of for this Operation are very dry, they muſt be pounded and put into a Cloth, and be expoſed to the Vapour of boiling Water, till they are penetrated with it quite through, and then if they are made uſe of, they will yield more Water and Oil, and it will be drawn from them too with leſs difficulty. It's ſurprizing now, how much theſe Oils differ from thoſe procured by Expreſſion, being theſe *per Deſcenſum* are abundantly more aromatic.

SCHOLIUM.

THIS Experimental Hiſtory of Oils prepar'd from Aromatics by the Chemical Art, eſpecially by Diſtillation, treated of from Proceſs 22, to this 30th, contains a great many things that are both curious and uſeful. With an Eye therefore particularly to the ſervice they may be of to you in Chemiſtry, Phyſics, and Medicine, I ſhall take notice of the chief of them, as carefully and ſuccinctly as poſſible.

1. All the aromatic vertue of Vegetables, then, conſiſts in their eſſential Oil alone, which being perfectly ſeparated from them, the remaining Subſtance has not the leaſt of this quality remaining.

2. But in this Eſſential Oil, again, it is an exceeding ſubtil, volatile, pungent Spirit, ſo little in quantity, that its weight is ſcarcely perceptible, that contains all that vertue which gives the Oil its efficacy, and which therefore being diſſipated, the Oil becomes abſolutely vapid and effete. In theſe Oils, therefore, we muſt always carefully diſtinguiſh the Sulphur from the Spirit, or the reſinous part, from the acrid igneous one. From its natural volatility, the Spirit ſoon exhales, and then the ſulphureous part remains inactive. And in the open Air this Oil will, in a ſhort time, in a cloſe Veſſel, in a longer, be inſpiſſated through various degrees, and ſo be gradually changed from a liquid Oil to a thicker, from this to a Balſam, from this again to a more tenacious Body, and at laſt by age into a brittle Reſin; which again by a new Diſtillation, may be converted into a thin liquid Oil. Hence ſome famous Authors have been of opinion, that diſtill'd Oils are actually melted Reſins, and Reſins only condenſed Oils. *Bohn. Diſ. Chem.* p. 29, 319, 326. The Sun certainly does change the Oils of Vegetables in this manner; for if you make a puncture in the Fir, Cedar, Larch-Tree, or Pine, there will in a ſhort time diſtill from

them a liquid limpid Oil, and how ſtrongly this is impregnated with a rich aromatic Spirit, I have often obſerved with admiration: But when this comes to the Bark, by the heat of the Sun it begins gradually to loſe its Spirits, and at the ſame time is inſpiſſated, and becomes a thick Turpentine, more denſe than the former Oil, but leſs pregnant with Spirits. And even this very Turpentine, when it is longer expoſed to the action of the Sun, and farther concocted, puts on the nature of a Reſin, loſing gradually its aromatic Spirit, till it at laſt retains very little, either Smell or Taſte. And hence, when we ſay that a Reſin, by Diſtillation with Water, may be reſolved again into an Oil, this muſt be underſtood only of the ſulphureous part, and not of the ſulphureous and reſinous together, for the Spirit is not regenerated, or returns again, but only the fluidity of the Oil. And the aromatic ſcented Tears, too, of Benjamin, Gum-Lac, Maſtic, Olibanum, and Sarcocolla, have loſt a great deal of the Spirits which were contained in them whilſt they were fluid Oils. Hence, therefore, the freſher and more liquid theſe are, the more beautiful are their medicinal effects, for by age they become quite effete. Nay at laſt, when the Spirit is quite gone, the inactive oily *Reſiduums* ſcarcely differ from one another. And for this reaſon, I can hardly help thinking, that the ſubſtance of eſſential Oils is very nearly the ſame, the Spirits giving to each its peculiar and diſtinguiſhing qualities. Does their particular ſpecific gravities depend upon their Spirits likewiſe? This, if you chuſe to engage in it, is proper matter of Inquiry. We here, however, muſt carefully obſerve, that the acrid Taſte and power of a Plant may be owing to the Salt; but then the private proper Character does not depend upon that, but upon the Spirit of the Oil, as in the Hiſtory of the Production of alcalious Salts, and the ſeparation of the native Salts of Vegetables, has appeared already: When theſe loſe their Oil, their diſtinguiſhing qualities periſh likewiſe.

3. The more pungent the Smell of any vegetable Subſtances are, or the hotter and more biting their Taſte, the more igneous will be the power of the Spirit that reſides in the diſtill'd Oil. Thoſe too that are come to full maturity, and are gently dried, yield a thicker, ſtronger, and deeper colour'd Oil: Thoſe that are freſh and moiſt when diſtill'd, afford a ſmaller quantity, and the Oil is thinner, clearer, and leſs igneous; but at the ſame time it is more fragrant. Does the Spirit itſelf of Vegetables, therefore, gradually increaſe in vigour, till it arrives at laſt at his higheſt ſtate? Certainly, in moſt of them, the Scent and Taſte, which are the effects of theſe Spirits, are not ſtrongeſt in the beginning, but when the Plant is in its full perfection. But here again we muſt take notice, that in ſome Plants there ſeems to be contained a larger quantity of Spirits in a leſs of Oil, whilſt in others there is a leſs quantity in a greater. Thus one pound of Nutmegs will yield an ounce of Oil, tho' you can procure but the ſame quantity from five and twenty pounds of *Calamus Aromaticus*, whence it appears, that there is not in them both the ſame proportion betwixt their Oil and Spirits. But there is a particular Acrimony too in theſe Spirits which thus diſtinguiſh the Oils; for in Oil of Cinnamon, like Fire it burns any part of the Body it is applied to, nor can it be waſh'd out under a long time. Savory too, and Thyme, yield a very hot Oil, nay perhaps the moſt acrid of all. Hence then we ſee the wonderful nature of theſe Spirits, which when they have exhaled from their Oils, ſcarcely at all diminiſh their weight, and

yet deprive them of their vertues, and leave them effete, thick, of a terebinthinaceous, and at laſt of a reſinous Nature. I have examined into the weight of theſe Spirits, but never cou'd diſcover any.

4. Diſtill'd eſſential Oils are found to be of different Colours, as they are procur'd from different Plants: Thus that of Mint is brown, of Lavender yellowiſh, of Cinnamon of a gold Colour, of Wormwood a black-green, of Camomile and Yarrow bluiſh, of Aniſe almoſt white, and of Camphire quite ſo. Does this variety ariſe from a difference in the Spirits, or from the Oil, or from ſome third Principle that riſes likewiſe from ſome Vegetables in Diſtillation? This certainly, which hitherto is not ſufficiently clear, deſerves to be inquired into.

5. Some of theſe Oils again are exceeding liquid, nay almoſt ſpirituous, of which we have an inſtance in the eſſential Oil diſtill'd from the Peel of *Lisbon* Oranges, than which ſcarcely any is thinner. Of this kind too is that from Lavender, and that very heavy one that is drawn from Saſſafras. Others on the contrary, are thicker, as thoſe of Fennel and Roſes; ſome thicker ſtill, as that of Aniſe; and yet another ſort exceeding theſe in thickneſs, as Camphire. The thickeſt, however, melt with a gentle heat, the next thick with a gentler, and the leaſt thick with the leaſt of all? Whence again is this?

6. But theſe Oils differ in a particular manner in their ſpecific gravities, ſome of them being even heavier than Water, and that too by a conſiderable exceſs of weight. Of this kind are the Oils of Cinnamon, Cloves, Saſſafras, Nutmegs, and I imagine of other Aromatics that grow in the hot Countries betwixt the Tropics; and theſe require a ſtronger Fire, and a lower Veſſel for their Diſtillation, and that only one fourth part of it ſhould be empty. But other eſſential Oils, on the contrary, are very light, as that diſtill'd from Lavender. This exceſs, however, of Weight, don't of conſequence render the heavieſt Oils the thickeſt; for as I hinted juſt now, Oil of Saſſafras is exceeding heavy, and at the ſame time very thin; Camphire is very thick, and yet very light: This therefore muſt be ſought for ſomewhere elſe. Oil of Aniſe will often keep ſuſpended in Water; that of Juniper-berries ſometimes ſinks to the Bottom.

7. In theſe aromatic eſſential Oils, there is an inimitable vertue depending intirely upon the Spirit we have ſo often mentioned, which is acrid, heating, and inflaming, but which at the ſame time is grateful and reviving, invigorates the animal Spirits, ſtimulates the Nerves, and thus diſſolves cold viſcid Humours. By theſe qualities, therefore, they are of ſervice to Perſons in years, in cold, watery, pituitous habits of Body, in cold intermittents, in moiſt cold hypochondriacal and hyſterical Diſorders, in cold, watery, mucous Flatulencies, and in cold acid pains of the Bowels, both Iliacal and Colicky. And, indeed, if they are uſed in theſe caſes by a prudent Phyſician, they prove a noble and very ſafe Medicine. When they are given, however, in Diſeaſes, where there is too much Motion, Heat, and Inflammation, by the unſkilful application of them, they prove perfect Poiſons. The Chemiſts have wiſely obſerved, that Oils act by their Spirits, and that theſe Spirits being entangled and retained by their Oils, may be ſo applied to any part of the Body, as to exerciſe their proper Powers, which, were they at liberty, on account of their volatility, they would ſoon loſe the capacity of exerting: Being thus united, therefore, they act with more

conſtancy, tho' at the ſame time, indeed, in a milder manner. But that you may enter thoroughly into a notion of this matter, let me obſerve, that in theſe Spirits, and conſequently in the Oil that contains them, there is an Acrimony, which diſcovers itſelf evidently by a Senſation like that which Fire impreſſes on the Tongue, which is immediately ſucceeded by pain, and that a conſiderable one too, and of the ſame kind with that which Bodies excite when they are applied to the bare Nerves. If they are laid on the Skin, they ſoon run through all the ſteps of an Inflammation, and in a ſhort time produce a gangrenous Eſchar. And when they are applied to the Lips, the inſide of the Noſe, and the *Velum Pendulum Palatinum*, where the Nerves are cover'd with an *Epidermis* only, without the *Cutis*, they there have the moſt violent effect of all, and hence they ſoon excite there moſt terrible Inflammations. Hence it appears then, what ſad effects, in the *Fauces*, *OEſophagus*, Stomach, and Inteſtines, may follow the taking theſe Oils imprudently. Theſe, therefore, with the greateſt juſtice, are called inflammatory Oils. In the mean time, however, as I took notice before, there is nothing that more immediately revives the languid Spirits than theſe Oils do, by the grateful influence they exert upon them, not ſo eaſy to be explained from any common principles, as to be learnt from the event of Experiments. In theſe certainly there is a power of ſoothing, comforting, and invigorating the animal Spirits. But they have a power of heating likewiſe; for whether they are taken inwardly, or applied outwardly, they immediately begin to warm the human Body, and when the Heat is once begun, increaſe it by very ſwift degrees. The colder, however, the Body is from a *Languor* of the animal Powers, the leſs effect they have upon it in this reſpect, and the contrary; and hence if they are rubb'd upon a dead Body, they communicate to it no degree of Heat at all. With what imminent danger, therefore, are theſe preſcrib'd in a burning Fever? They put the Nerves too into action, by ſtimulating them, and propelling the animal Spirits, and perhaps by ſoothing both of them with a grateful ſweetneſs. And whilſt they act in the manner thus explained, they attenuate and reſolve any Viſcidities that can be diſcuſſed by an increaſe of the vital Motion. But there are other vertues likewiſe, and thoſe too not leſs remarkable, which are proper to certain Spirits only, and of which we treated ſufficiently under the head of diſtill'd Waters, particularly cohobated ones. The Oils of the *Arbor Vitæ*, and Savine, are ſtrong Emmenagogues, where the retention is owing to a languid habit of Body. Oil of Rue is of excellent ſervice in Epilepſies ariſing from a cold lax Conſtitution, as it is likewiſe a good anti-hyſteric, where the diſorder is produc'd by a cold Cauſe. In a cold Scurvy, and the heavineſs, and pains that proceed from it, Oil of Juniper-berries is wonderfully efficacious, and happily too removes thoſe obſtructions of the Kidneys that are occaſioned by this *Inertia*. Oil of Mint overcomes the languid Diſorders of the Stomach, even tho' it is almoſt paralytic. Palſies, Giddineſs, Lethargies, and other Affections of the Brain, ariſing from a cold cauſe, are beautifully relieved by Oil of Lavender; whilſt Oil of Roſes, by its delightful fragrance, without any inconvenience from its Heat, gratefully revives and exhilarates the Heart. But in Women with Child, in Labour, or that have lately lain-in, where their Spirits are much ſunk without any Inflammation, or Veſſels burſt, or open, there is nothing equal in vertue to Oil of Cinnamon. If the Oils of Wormwood, *Carduus Benedictus*, leſſer Centaury, Camomile,

Camomile and Tanſy are made into Pills with ſome Crumb of Bread, and taken upon an empty Stomach, about 2 Hours before eating, what a certain Remedy are they in Worms? And laſtly, thoſe choice and noble Oils of Baum and Lemon-Peel are greatly ſerviceable in Palpitations of the Heart ariſing from a cold, watery, inactive, *mucus*; as thoſe of Marjoram, Roſemary, and Sage are ſingularly ſo in viſcid, cold diſorders and diſcharges of the *Uterus*.

8. If theſe Oils are rubb'd ſtrongly, and for a good while, with twice their weight of the pureſt, drieſt Sea-Salt, and are then diſtill'd again *per Veſicam*, they become pure, and limpid, and are freed from the gummy Mucilage, as it were, of the Water, and hence are fitter for keeping without loſing their Vertue, if you put 'em into glaſs Vials, with narrow Necks, that han't too much Salt in their compoſition, ſtop 'em well with Glaſs Stopples, nicely ground to the Necks, and ſet 'em in a dry, cool place. In this Purification, however, the quantity of the Oil is leſſened, as a good deal of the viſcid part remains at the bottom of the Still, which, on account of its tenacity is not able to riſe. And their Vertues, which depend upon their Spirits, are by this Operation diminiſhed likewiſe; for ſome of theſe remain in the Water in the Still, and ſome are diſperſed through that which riſes in the Diſtillation. This Monſ. *Homberg* demonſtrated by an elegant but coſtly Experiment, whilſt he diſtilled ſuch an Oil ſix and twenty times with freſh Water, by which means he had left at laſt only one quarter of the Oil, three quarters being converted into an inſipid, tenacious Liquid. And Water being cohobated four and twenty times with ſuch an Oil, acquired a very aromatic, ſaline, or ſpirituous Acrimony. *Du Hamel. Hiſt. de l'Ac. Roy. des Sc.* p. 143.

9. If theſe Oils, when they are pure, are diſtilled in a glaſs Retort, without the addition of any thing elſe, and you gradually increaſe your Fire, there always exhales from them ſomething of Water, and they become clearer, thinner, lighter, and more penetrating; and when you have urged them with a very intenſe Fire, they leave a fixed, black, ſpongy, terreſtrial Matter, at the bottom of the Retort. And if you patiently repeat this Operation in the ſame manner, you will at laſt convert the greateſt part of the Oil into ſuch *Fæces*, call'd by the Artiſts, the *Caput Mortuum*. The great *Boyle*, by this method reduced almoſt a whole pound of diſtill'd eſſential Oil into Earth. See the Obſervations at the end of his Treatiſe *de Noctiluca Aeria*.

10. Five ounces of this Oil being cohobated 8 times upon 15 ounces of the pureſt Chalk, in very clean Veſſels, was reduced to 2 ounces and 1 drachm of Oil, 2 drachms and 45 grains of Salt, and 1 ounce and a half of a very ſtrong, ſaline Water, in which there was a volatile Salt of the Oil. This we have upon the Authority of Monſ. *Bourdeline*, mentioned by *Du Hamel*, *Hiſt. de l'Acad. Roy. des Sc.* p. 413.

11. Theſe Oils, by being diſtilled from quick Lime, that is ſlaked in the Air, and afterwards rendered exceeding dry, are ſo alter'd, that 1 pound of Oil being 6 times cohobated with a very great degree of Fire upon freſh Lime, there were drawn off 15 ounces and a half of Water, and 1 ounce of Oil. *Homberg*, *ib.* p. 372. It is ſuppoſed therefore to be abſolutely certain, that theſe Oils conſiſt chiefly of elementary Water, Earth, a ſmall quantity of Oil, and ſome Spirit and Salt (*Mem. de l'Ac. Roy. des Sc*, 1703. p. 37.) and conſe-

quently, that this diſtill'd eſſential Oil is not a ſimple Element, but is actually compounded of theſe different Principles, united by the action of the Fire into one Body, called an Oil. Whether this, now, is really the caſe, or whether the Event of ſome other Experiments don't make it more probable that theſe Oils are really tranſmutable into theſe Principles, I won't at preſent undertake to determine.

12. But this, in the mean time, I can aſſert with greater certainty, that if the choiceſt of theſe Oils are diſſolved in Alcohol of Wine, and are then diſtilled with the gentle Heat of 100 degrees, they will give out their *Spiritus Rector* with the alcohol, the oily, tenacious part remaining at the bottom. And if the *Reſiduum* is then treated in the ſame manner with freſh Alcohol, it will again impregnate it with more Spirits; and if this is ſufficiently repeated, there will at laſt remain at the bottom an inert, inodorous, inſipid, thick, tenacious Oil, quite depriv'd of all its Spirit. Nay, if pure Water is well ſhook together with ſuch an eſſential Oil, it will attract its Spirits out of it, and be richly impregnated, and if this is long enough continued, there will at length be left only ſuch an Oil as we juſt deſcribed. Upon theſe Principles now are made ſome very beautiful Preparations: And hence we ſee, that theſe Oils are reſolv'd into an Oil and a Spirit; as they are likewiſe into a ſmall quantity of Salt, a Water, and a great deal of Earth; at leaſt theſe are produced from them by Diſtillation. But there is nothing in this Affair that ſeems more ſurprizing, and a greater Paradox, than that Water ſhou'd be ſo intimately united with theſe Oils, as not to be ſeparated from them, even by 20 diſtillations.

13. In the laſt place then, from this whole Hiſtory of eſſential Oils, it again appears, 1. That the peculiar Smell, and Taſte of Plants reſides only in their *Spiritus Rector*. 2. That the proper Smell and Taſte of diſtill'd aromatic Waters, drawn from different Plants, is contained, likewiſe, in this Spirit alone. 3. That it is this Spirit intirely, that gives eſſential Oils their diſtinguiſhing properties. 4. That the volatile Oil of Vegetables ſerves principally to entangle and retain this Spirit; whilſt the more fixed is a *Vinculum* to hold together the more ſolid parts; on which account they differ as much as poſſible from one another. 5. That the expreſs'd Oils, and the diſtill'd ones we have juſt been treating of, are natural enough to the Plants they are procured from. 6. And laſtly, that the principal difference betwixt the Oils conſiſts in their Spirits. See, by all means, upon this head, the Obſervations of Monſ. *Homberg*, in the places above cited, and *Hoffman*'s *Deſert. Phyſ. Chem.* from p. 1. to 63.

PROCESS XXXI.

A Rob *prepared from the* Reſiduum *of the Proceſſes* 23, 24, 25, 26, 27, 28, 29.

APPARATUS.

WHEN the Oils are perfectly ſeparated from Plants by the help of Water without the addition of any thing elſe, then the Decoction that remains in the Still is exactly the ſame as wou'd have been produced by boiling the

Plant in Water, for the ſame time, in a common Veſſel. Hence therefore thoſe other Vertues of Vegetables, that do not depend upon theſe Oils and Spirits, will remain in theſe Decoctions, unleſs they have undergone ſome Alteration by being boiled ſo long in cloſe Veſſels. But when theſe reſiduary Decoctions, with the Waters drawn off, are made uſe of a ſecond time, with freſh Plants, for preparing the ſame Oil; then this ſecond Decoction will be ſtronger than the firſt; and ſo on. And hence by a frequent repetition of this Operation, theſe decoctions at laſt become richly impregnated with thoſe Vertues, as I took notice before in our account of diſtill'd Waters prepar'd by Cohobation, where I endeavour'd too to determine what thoſe Vertues chiefly were. Thus the Decoctions from Wormwood, Betony, Germander, Ground-Pine, Fennel, Juniper Berries, Tanſy, and many others retain conſiderable Medicinal Vertues; for they have often a ſaponaceous quality, and a ſaline Acrimony by which they are capable of doing a great deal of good. And *Van Helmont* very juſtly informs us, that the Decoction of Juniper Berries, that remains after the Oil is drawn off, has an excellent purging quality, if it is but drank in ſufficient quantity. If theſe ſtrong Decoctions now are diluted with a good deal of Water, and whilſt they are boiling hot are ſtrained through a woollen Bag, and then inſpiſſated in an open Veſſel with a clear Fire, ſtrong enough to make 'em juſt ready to boil, they will be converted into a *Rob*, which will poſſeſs their Vertues, retain them uncorrupted for a great length of time, and in a ſmall Doſe, will have a conſiderable effect. And if theſe Decoctions are inſpiſſated, and burnt, according to *Tachenius*'s method, they will yield a great quantity of the Salt that goes by his name. But if they are very nicely purified by ſtraining 'em, and then inſpiſſated to a proper thickneſs, and ſet by in a Veſſel, with ſome Oil poured upon them, they will then yield the native Salt of the Plant, which will more readily ſhoot, now the eſſential Oil is ſeparated.

USE.

THUS the Chemiſt then, for the uſe of the Phyſician, procures vegetable Oils, Waters, Extracts, native Salts, and calcin'd ones, almoſt by the ſame Operation, by compounding which afterwards together are prepared very beautiful Medicines: For if the Oil of Juniper, for inſtance, is rubb'd well with its native Salt, and this Compoſition is accurately mixed with its *Rob*, and the whole is diluted with its diſtill'd Water, you will then, in a ſmall compaſs, have almoſt all the Vertues of the Juniper, nothing hardly but its terreſtrial part, which impeded its activity, being taken away. From all that has been ſaid then we learn what the various parts are that the chemical Art is capable of extracting from vegetable Subſtances, and how much one forwards or hinders the production of another.

PROCESS XXXII.

Diſtill'd Oils, Vinegar, Spirits, a twofold Oil, a Coal, and Aſhes from Guaiacum-wood, diſtill'd in a Retort without the addition of any thing elſe.

APPARATUS.

1. THE Vegetables which I have hitherto examined by a chemical *Analyſis* ſeem reducible to 2 diſtinct *Claſſes*, the firſt of which contains thoſe that, being diſtill'd dry, yield an oily, volatile, acid Salt, together with ſome other parts; the ſecond, thoſe which being treated in the ſame manner, beſides other volatile parts give out an oily, alcaline one; with this limitation, however, that both *Claſſes*, through various degrees, yield more or leſs of either, according to the diverſity of the Plants contained in them. Of both theſe, now, I will give you an Example, beginning firſt with the Acid, for which purpoſe I ſhall make uſe of the Wood *Guaiacum*.

2. With the raſpings of the beſt ſort of this Wood then, *viz.* that which is green, cloſe, heavy, and pretty freſh, I fill a clean glaſs Retort almoſt to the Neck, taking a great deal of care however that none of it can drop out of the Neck into the Receiver. This Retort I put into a Sand Furnace, and applying a very large Receiver, lute the Joint very cloſe with a Lute made of Linſeed Flower. I then begin the Diſtillation with a degree of Heat not greater than that of boiling Water, and keep this up as exactly as poſſible, as long as any Moiſture comes away with this Fire; and by this means I have a thin, acidiſh Water that is very ſtrong ſcented, which muſt be removed, and kept by itſelf. The Receiver being luted on again, if the Fire is gradually increaſed, there will come off another Liquor, ſtill pretty thin, more acid, oily, and of a reddiſh colour, which muſt be carefully urg'd with the ſame degree of Fire, ſo long as it riſes. This too may be kept by itſelf, and is pretty ſtrong and odorous, ſmelling exactly like Herrings that are dried in Smoke. The Fire being rais'd ſtill higher, and ſo kept up, will force out a red, pinguious Liquor, that is very acid, and with it a red Oil, which will ſwim upon that Liquor in pretty great quantity. And laſtly, if you increaſe your Fire till the iron Pot of the Furnace begins to be red hot, there will then riſe a Fume, and at the ſame time a thick, black, tenacious Oil, which will ſink to the bottom of the former Liquor; and though you keep up your Fire to as great a degree as the Glaſs is able to bear without melting, yet ſtill there will be Fumes floating about, urge it ever ſo long. Then lay ſome live Coals upon the Sand over the Retort, which is called *(ignis ſuppreſſionis)* a ſuppreſſing Fire, and let this be kept up ſo long as any Oil comes off, the Fumes however ſtill remaining in the Receiver. This being done, let the whole ſpontaneouſly cool, and by this laſt extreme torture of the Fire you will yet have a ſmall quantity of a very thick, black, heavy Oil, not unlike Pitch.

3. Make a little Bag of Filtering-Paper, place it in a glaſs Funnel, and pour into it the Water that comes firſt off from the *Guaiacum* without any Oil, that the Bag, when it comes to be wet, may tranſmit this Water, to be kept by itſelf:

This is acidiſh, thin, penetrating, and has ſomewhat of a burnt Smell, reſembling that of Herrings dried in Smoke. Let the ſecond Water then be filtered thro' the ſame Bag, and it will paſs through reddiſh, limpid, acider, and much more acrid, having a diſagreeable Smell, coming much nearer to that of ſmok'd Herrings, and exhaling ſomewhat empyreumatical: And if there happens to be any Oil amongſt this ſecond Water, that will be ſtopp'd in the Bag, for when it is once thoroughly wetted with the firſt Water, it will not ſuffer any Oil to paſs through it. When this is done, pour in the Vinegar, and third Spirit with its light Oil, and the Vinegar will immediately run through, red, limpid, acrid, and acid, having a burnt empyreumatical Smell, and the Oil will ſwim at top of the Liquor in the Bag, for which reaſon it is neceſſary to keep the Bag always full, by continually pouring in more of this oily Liquor, that the Oil may be kept from ſinking down to the bottom, by which means you'll be able to prevent any of it from running through with the acid Liquor. When almoſt all the Liquor is thus filter'd, move the Funnel and Bag immediately into another Veſſel, before the Oil begins to inſinuate itſelf through the Paper, which will happen as ſoon as ever this comes to be dry: And this light, thin Oil may be poured out of the Bag into a Veſſel by itſelf. Then take the laſt Oil with its very acid, fetid, pinguious Liquor, and pour it into the Bag whilſt it continues wet with the former, and there will run through a red, acid, limpid Liquor, a thick, black, pitchy, heavy Oil remaining in the Paper, which, as the former, may be then poured out, and kept by itſelf.

4. If theſe acid, aqueous Liquors are put into clean glaſs Veſſels, they generate an oily Cruſt on the bottom and ſides of the Veſſels, which gradually increaſes, whilſt the acid Liquor at the ſame time grows by degrees leſs and leſs oily. Hence then it appears, that this diſtill'd Vinegar is compoſed of Water, an Acid, and an Oil, and conſequently, that this Liquor with the greateſt juſtneſs ſhou'd be call'd an oily, ſaponaceous, volatile, acid Salt. If this acid Liquor, when it is exceeding limpid, nor diſcovers the leaſt viſible Oil, is poured upon pure Chalk, it produces an effervefcence, depoſites its Acid in the Chalk, becomes Water, and at the ſame time diſcovers an Oil, before latent, which it caſts up to the top. And if you take the ſame Liquor, and diſtill it afreſh with a gentle Fire, there then too is ſeparated an Oil, which did not appear before, and you have a pure, acid, limpid Liquor remaining.

5. If a Perſon has a mind to carry theſe Oils to greater perfection, after he has collected a proper quantity, he muſt diſtill them with boiling Water, by which means the purer part will aſcend, whilſt the thicker remains at the bottom. And if this is repeated, they gradually approach nearer and nearer in goodneſs to the former eſſential Oils, the inert, terreſtrial part, in particular, being ſeparated from them, whilſt they themſelves become thin, limpid, of a beautiful red colour, exceeding penetrating, pure, and not fetid.

6. When, by the methods above-mentioned, all the volatile parts have been forced out by the extreme and long-continued action of the Fire, there will then always remain in the Retort a very black, light, inſipid *Caput Mortuum*, which has very little Smell, and is very brittle. And this is the true Coal of *Van Helmont*, which, urge it ever ſo long with the intenſeſt Fire in a cloſe Veſſel, can never be reduced to white Aſhes, but will continue black, and purely on account of this blackneſs, will always remain inflammable: For

that which gives it this blackneſs is an exceeding fixed Oil, which very tenaciouſly adheres to an Earth, and is ſpread very finely over its Surface, and hence is properly diſpoſed to receive and ſupport Fire, 'till it is conſumed. To demonſtrate now this before you, in this earthen Diſh I ſpread this black Maſs juſt as it comes out of the Retort, and in the middle of it lay a live Coal, and you ſee it is raiſed into a bright Fire, which, ſpontaneouſly ſpreading itſelf on all ſides, converts all the black parts into pure Fire, and then into Aſhes, ſo that the whole Raſpings, by the propagation only of one ſmall ſpark, are gradually conſumed into Aſhes. Nor perhaps can this eaſy accenſion of Wood by ſo ſmall a Fire be eaſily brought about in any other manner than by firſt reducing it to a Coal, and then breaking this to Powder. Theſe white Aſhes now, thus prepared from *Guaiacum*, are inodorous and almoſt inſipid; but from the green Wood treated in this manner they conſiderably abound with an alcaline Salt.

USE.

IN this Operation we learn a good many very remarkable things, which inſtruct not the Chemiſt only, but the Phyſician, and natural Philoſopher likewiſe.

1. For Inſtance, we hence diſcover the nature of that ſmoky Vapour, which firſt exhales from green Wood, when it is laid on the Fire, before it grows black, flames, or is red hot: For in this caſe there exhales an acid Water, conſiderably acrid, which makes the Eyes ſmart, and penetrates any animal ſubſtances that are hung in the Chimney, and ſo preſerves them from putrifaction. A Liquor very much like this too is collected from green Wood, when you lay a long Stick on the Fire in ſuch a manner that both ends ſhall be out of it; for then the Fire fuſing the Juices in the middle, drives out a large quantity of an acidiſh Water at the ends, greatly reſembling that which firſt riſes in Diſtillation.

2. Hence appears likewiſe the Nature of that ſmoky Vapour which riſes from dry Wood, when that is laid upon the Fire, and which comes from green Wood, when the Vapour juſt deſcribed is all gone off, that is to ſay, before either of them begin to be red hot, or Flame; for this ſmoke is denſer, more acrid, acid, and heavy than the former, contains more acid Salt in it, and begins to grow a little black; and hence it makes the Eyes ſmart a good deal worſe. Fleſh and Fiſh hung up in the Chimney, it penetrates more effectually too, prevents their corrupting, and in ſome meaſure tinges them of a red colour; and hence it muſt carry up ſome of the firſt Oil of the Wood along with it.

3. But from the preceding Operation we underſtand farther, the nature of that thick, black, and very acrid Smoke, which riſes from Wood when it is juſt ready to burſt out into Flame; for this contains a large quantity of a very acrid, fixed, acid Salt, together with the firſt, ſecond, and third pitchy Oil, which being in this Smoke all blended together, give the Eyes an intolerable degree of pain. This likewiſe penetrates the Bodies that are expoſed to it, and by its acid Salt ſecures them from corruption, but at the ſame time makes a greater alteration in them by giving them another Smell and Taſte.

4. Hence then it is evident, that Vegetables afford a Water, in which there is contained an acid, oily, volatile Salt, which being thus pure, has a very penetrating, aperient, attenuating, antiſeptic, detergent, and ſaponaceous Vertue, on which account it is antiſcorbutic, diuretic, diaphoretic, and ſudorific, eſpecially when it is properly depurated, and rectified. Externally, it is of ſervice likewiſe.

5. Who cou'd have believ'd now that ſimple elementary Water could for Years remain in Wood, united with its other Elements, in a hard dry form? I diſtilled once ſome Raſpings of *Guaiacum* that had lain ſome Years in the open Air, and hence were grown as dry as Sand, and the acid, aqueous Liquor, which was ſufficiently pure, being collected by itſelf, eaſily gave out its Acidity into Chalk, or a fixed Alcali, and ſetting aſide a ſtrongiſh Smell, which remain'd in it, became a pretty pure Water, of which there was a conſiderable quantity; which Water therefore was concreted with the *Guaiacum* in *America*, remained united with it ſo many Years, and actually helped to compoſe that very heavy, hard, dry Wood, but upon diſtillation recovered its original form of Water. Hence then we ſee evidently, that Water may lie wonderfully conceal'd in union with Bodies, where one would not have the leaſt ſuſpicion of it, nay and actually be the cauſe of their Hardneſs; for as ſoon as ever the Water is ſeparated by Fire from the other parts, they immediately grow ſoft, and brittle, nor cohere with any conſiderable force, though before, whilſt the Water remained among them, they together form'd a Wood almoſt as hard as Iron.

6. And here we obſerve, that the mixture of different Elements, in a certain proportion, will produce compound Bodies very unlike thoſe Elements.

7. But hence it appears yet farther, that Water, an acid Salt, a Spirit, Oils, and Earth, are ſo intimately mixed, and tenaciouſly united together by Nature in the production of Vegetables, that they will not only remain ſo for Ages, as we ſee in Cedar, *Guaiacum*, Juniper, and others, but will in Diſtillation likewiſe riſe together; for we find that Water is contained in the Oil itſelf, and Oil in the Water, though without any viſible mark of their being there.

8. And laſtly, hence we learn likewiſe, that there is in Vegetables an exceeding fixed Oil, which, when all the volatile parts are intirely expell'd, remains united with an Earth, and that matter, which by an open calcination is converted into a fixed Alcali: That this Oil cannot, in a cloſe Veſſel, be ſeparated and forced out by any degree of heat whatever, but continues of an exceeding black colour, nor diſcovers in the Maſs the leaſt ſign of oilineſs: That this is very finely extended over the Earth, and fixed Salt, and hence will take fire ſo eaſily, that if the leaſt Spark falls amongſt it in the open Air, it will receive and propagate it to every part: That this Oil yields a Fire that is not very ſmoky, but that has a balſamic, aromatic Smell; and that this ſmall quantity of Oil, ſo long as it remains, prevents the Salt's being ſeparated from the black Coal, which Salt, when the Oil is conſumed by Fire in the open Air, immediately diſcovers itſelf in the Aſhes that are left behind. Theſe things then being properly attended to, teach the proper nature of a vegetable Coal; and why the Powder of it by being mixed in Chemical Operations with the Bodies to be operated upon, often produces ſuch unexpected and extraordinary effects, eſpecially upon ſulphureous ones. Hence we underſtand too, that the fixed Alcali of theſe Coals is generated ſlowly, nor till all the inflammable parts are conſumed by the ſtrongeſt effect of Fire in the open Air: That the laſt Oil is ſo intimately united, and tenaciouſly

retained by the fixed Matter of the Plant, that it cannot be diſengaged and ſeparated from it by the ſole action of Fire, but only when the Air concurs with it: And that hence, in Diſtillation perform'd in cloſe Veſſels, the volatile parts may be drawn off, *viz.* the Water, Spirit, acid Salt, and a two-fold Oil, and together with all theſe, a good deal of Earth, but that there will ſtill remain at the bottom, the fixed Oil of the Coal, that matter which by an open Fire is convertible into a fixed Alcali, and more Earth in a large quantity. Thus then we ſee the Effect of Air and Fire uniting their influence, and acting together upon Vegetables.

9. This Experiment holds univerſally in all Trees, Shrubs, and a great many Herbs, which being treated in this manner, yield all theſe volatile and fix'd parts; for in all theſe there is a volatile acid Salt, and a Matter, which being burnt in an open Fire, will yield a fixed, alcaline one. The freſh Twigs of the Vine, cut in the beginning of *March*, afford in Diſtillation a large quantity of an Acid, as the *Caput Mortuum* burnt does of a fixed Alcali.

PROCESS XXXIII.

Water, Spirits, an oily, alcaline, volatile Salt, an Oil, and a Coal, procur'd from Muſtard-ſeed by Diſtillation in a Retort.

APPARATUS.

1. EVERY body knows that there are both parts of Plants, and whole ones, which, if they are bruiſed, or ſcrap'd, give out a very acrid Vapour, which ſtings in the Noſe, and makes the Eyes ſmart and water, and at the ſame time diſcovers a very pungent Smell. Of this kind are the Bulbs of Garlick, Onions, Hyacinths, Narciſſus's, Leeks, and Squills. Some Roots too have this property, as the Garden Radiſh, eſpecially the thick, round one, both white and black; and ſome Seeds likewiſe, as thoſe of the Wild Radiſh, Scurvy-graſs, Rockets, Flix-weed, Radiſhes, Muſtard, and Mithridate Muſtard. But there are a great many whole Plants too that are alſo referr'd hither, the chief of which are Jack by the Hedge, Garlic, Cuckow-Pint, the Aſphodil, Cabbage, Briony, Onions, Camomile, Celandine, the Rock-Roſe, Scurvy-graſs, the Wild Cucumber, Sow-bread, Dutroy, Rochets, Flax-weed, the *Indian* Tithymal, Herb Robert of the Wall, Clary, Hyacinths, Henbane, Orris, Dittander, Lilies, Hops, the Love Apple, the Mad Apple, Creſſes, Satyrion, Poppies, Ranunculus's, Cherlock, Water-germander, Muſtard, the biting Stone-Crop, Tabacco, the Deadly Carrot, Hedge-Muſtard, and Spurge: If you treat any of theſe now in the ſame manner, you have pretty nearly the ſame ſucceſs, as you have likewiſe with moſt virulent, cauſtic Plants.

2. From among theſe now, I take the common Muſtard-ſeed thorough ripe, and filling a Retort with it to the bottom of the Neck, lute on a pretty large Receiver, and gradually diſtill with a Sand Heat. The firſt Liquor then that comes off, is oily, and of a yellowiſh Colour, and being collected by itſelf, is limpid, and acrid. The Fire being then increaſed, there riſes another Spirit like the former, but more yellow, and at the ſame time a light and a very pinguious Oil. Theſe again being ſav'd by themſelves, are very acrid. The

Receiver being again luted on as before, I make the Fire ſtronger underneath, and at the ſame time lay live Coals upon the Sand above, by which means there aſcends from the remaining Maſs a large quantity of a light black Oil, and, at the ſame time you have an oily alcaline volatile Salt all about the ſides of the Receiver, collected into little ſpots, as uſually happens in the diſtillation of Hartſhorn. If you then keep up the Fire in this degree for a great length of time, there will always riſe ſomething of a Vapour of a whitiſh Colour; and at laſt there will be left in the bottom of the Retort, an exceeding black Maſs, form'd as it were of the melted Seeds, which will be very light, bitter, and not Salt.

3. If you take the firſt and ſecond Spirits, and in a clean Retort diſtill them again with a gentle Fire, they yield a limpid, acrid Spirit, pretty much like that of Hartſhorn, and uſed nearly for the ſame medicinal purpoſes; and at the bottom of the Retort there remains an oily, fetid Water.

4. If from the laſt Liquor and Salt, you ſeparate the Oil, and then waſh off the Salt that adheres to the ſides of the Receiver with the rectified Spirit juſt mention'd, you will have a Liquor impregnated with a volatile alcaline Salt, which with Acids will cauſe a ſtrong Efferveſcence: And if you then diſtill this with a gentle Fire in a tall Veſſel, it will by this Rectification yield a pure volatile Salt, like that of Hartſhorn.

5. All the Oils thus drawn off, have conſtantly the fetid rancidneſs of diſtill'd Oils, but by Rectification become purer, and leſs diſagreeable, being reſolved by this means into a great deal of Earth, and an Oil, which upon every Operation grows more and more pure.

6. What remains at laſt at the bottom of the Retort, appears to be a true Coal. But when you reduce it to a dry Powder, it always continues to be ſubpinguious, nor upon the application of a Spark to it, will it take Fire as the Coal from the *Guaiacum* did, in which property therefore theſe two differ from one another. If this is burnt in an open Fire, it leaves a little Earth, in which there is hardly any thing of a fix'd Salt, as far as I, upon Examination, have been able to diſcover. I have been inform'd however, by Perſons of undoubted veracity, that a large quantity of this Muſtard-ſeed Coal being reduc'd to Powder, and urged for a great length of time, with an intenſe Fire, in an earthen coated Retort, has at laſt, like Urine, yielded a true Phoſporus.

7. If all theſe Obſervations, then, which are pretty remarkable, are compar'd with what we ſhall hereafter demonſtrate in the analytical account of Animals, it will plainly appear, that this ſort of Plant, and thoſe mention'd in the beginning of this Proceſs, have ſuch an agreement with Animals, with regard to what is produc'd from them by a chemical *Analyſis*, that they differ very little, if any thing at all; unleſs, perhaps, from animal Subſtances there is drawn a little more Water that has no Oil in it, tho' it is not improbable but this too wou'd be the caſe in Muſtard-ſeed, was it diſtill'd green. In the mean time, however, this we are ſure of, that if a Muſtard-ſeed is ſown in the Ground, from the Juices that it draws out of it, it will produce a Plant, which will ſo diſpoſe the matter of Vegetation, that by a gentle action of the Fire, it will be converted into a volatile alcaline Salt; and conſequently, that this Salt is not ſo proper to Animals, but that it is found in ſome Vegetables likewiſe. Nay, this alcaline Salt appears more openly in Muſtard-ſeed, even without Fire, than

it does in Urine, which of all the animal Liquors is the moſt alcaleſcent: For I never yet cou'd procure any freſh human Urine that wou'd cauſe an Effervecence with Acids, tho' good Muſtard-ſeed will, by only being pounded and mix'd with ſtrong Vinegar. Hence, therefore, it appears, that a true oily, alcaline, volatile Salt, may be extracted from crude freſh Plants, without any previous putrefaction, and that as well from thoſe that are found in the Water, as Scurvy-graſs, Water-mint, and Horſe-radiſh, as thoſe that grow in places where there is a great deal of Dung, as Rockets, Flix-weed, and Muſtard. Who now cou'd have imagin'd, that a volatile alcaline Salt ſhou'd be generated in Water?

8. From what has been ſaid then, Phyſicians may be able to judge with certainty, in what caſes theſe Plants will prove beneficial. In thoſe Diſtempers where there is too great a quantity of an inert, inſipid Water, or a cold inſipid *Pituita*; where an Acidity prevails in the Juices of the firſt Paſſages; where the Bile don't properly perform its Office; and hence the whole Body is cold, heavy, and inflated; if there is no oily, alcaline, putrid diſpoſition of the Humours at the ſame time, theſe things, with prudent uſe, are of excellent ſervice. But where there is too much Heat; an acrid Bile; a feveriſh Diſpoſition; putrid Juices; an Inflammation; an Atrophy; or a putrid Scurvy: There on the contrary they do harm. And here it will be of conſiderable ſervice, to examine the whole Vegetable Kingdom almoſt, as it is divided into thoſe Plants that yield an acid Salt, and thoſe which yield an alcaline one.

PROCESS XXXIV.

The ſeparation of Oils from the other parts united with them in Diſtillation, on which depends their Rectification, Conſervation, and Converſion into a Balſam and Reſin.

APPARATUS.

1. IT is neceſſary we ſhou'd have Oils pure and free from every heterogeneous Matter, in order to examine them in a proper manner, preſerve them, and then likewiſe obſerve the alterations they undergo. This ſeparation now is uſually effected by the following Methods. 1. Of a ſpongy Paper make a conical Bag, fitted exactly into a glaſs Funnel, which muſt be ſet in the Mouth of a Bottle with ſome clean warm Water; wet this Bag in ſuch a manner, that it may be penetrated quite through; and then pour in the Liquor in which the Water, Spirits, and Oils are mix'd together: The Water, Spirits, and the Salt diſſolved in theſe then, will ſoon run through, and the Oil will remain in the Paper. Continue the pouring in of the Mixture till the whole is filter'd: But here you muſt obſerve, not to let the Oil be alone in the Paper, but always to pour in ſome more Liquor before all the Water of the former is gone through. By this means, you will at laſt have all the Oil alone in the Bag, which you muſt preſently pour out into a proper Bottle, and keep by itſelf. In this way, however, there is a good deal of Oil hangs about the Paper, and is loſt, and therefore for the more valuable, there is contrived another method of ſeparation. 2. Take a glaſs Veſſel with a long cylindrical

Neck, whoſe Mouth is widened a little into a rim; heat this, and pour into it the Water with the Oil ſwimming at top, till you have fill'd your Veſſel quite full. After then it has ſtood quiet ſome time, the Oil will riſe into the Neck, and the Water will be underneath. Gently pour off all the Oil, if you can, into another clean Veſſel, but if you can't, put in again as much hot Water as you took out Oil, which deſcending to the bottom, will force up the Oil into the Neck of the Glaſs, whence you may pour it out again, and ſo proceed, till you have ſeparated and collected it all. And this, by the heat, ſhaking the Veſſel, and fulneſs of it, may be eaſily effected within a few drops. 3. But the ſame thing is done likewiſe by a glaſs Veſſel, commonly called a ſeparating Glaſs, which has at the bottom a long, narrow, cylindrical, open Pipe, which is kept ſtopt till the Liquor is put into the Veſſel, and all the Oil is riſen to the top: This then being opened, the Water which is loweſt will run out firſt, and when this is ſo far gone that the Oil begins to come into the Pipe, ſtop it again, pour in more of your Water and Oil, let them ſtand quiet, and the Oil will be collected at top as before, upon which open the Pipe and let out the Water, and ſo proceed till all the Oil is collected in the ſeparating Veſſel by itſelf. 4. But if the Oil is ſo heavy as to ſink to the bottom of the Water, then if you put theſe into the ſeparating Glaſs, after they have ſettled ſome time, the Water will be at top, and the Oil at bottom, which therefore you may let out at the Pipe as you did the Water before, and ſo ſeparate it from the Water, and collect it together. 5. And laſtly, if after theſe valuable Oils are thus ſeparated, there is any Water ſtill remaining upon them, it is neceſſary it ſhould be taken off, otherwiſe it will make them mucilaginous: This then is done by making a kind of Tent with a piece of Cap-paper, wetting it thoroughly with warm Water, and then ſqueezing it out, and dipping the ſmall end of it into the Water upon the Oil, for by this means it will attract that into it, and leave the Oil pure.

U S E.

1. THE Oils being thus ſeparated and collected together, muſt be put into clean, ſmall, glaſs Vials, which muſt be exactly ſtopt with glaſs Stopples, and then be ſet in a cold, dry place, and open'd as little as poſſible, for fear the Spirit, which gives them their vertue, and value, ſhou'd exhale. And if you mix a little of the perfecteſt Alcohol with moſt of theſe Oils, they become thinner, more ready for uſe, and keep the better. By this means, too, they are prevented from being afterwards ſo eaſily inſpiſſated, that they won't drop conveniently out of their Veſſels; as well as from growing mucilaginous. This likewiſe ſecures them from contracting any rancidity, which perhaps they might do otherwiſe; nay, if they are actually begun to be changed, by the affuſion of Alcohol, they may be recovered again.

2. Theſe Oils, however, by length of time, will be thickened to the conſiſtence of a Balſam, and at laſt will harden into the form of a Reſin. And this in particular is haſtened by the *Spiritus Rector*'s exhaling, which happens chiefly from opening the Veſſel too often, ſtopping it careleſly, or, which has much the quickeſt effect, by leaving it quite open, eſpecially, if it ſtands in a warm dry place; for then they will in a ſhorter time be converted into a Reſin. For

this reaſon, therefore, I have ſometimes been ready to doubt, whether it may not poſſibly be the Spirits that keep theſe Oils in a ſtate of fluidity. I once my ſelf put ſome ſuch very pure, liquid, diſtill'd Oil into a Vial, and when about a year afterwards I had occaſion to make uſe of it, I was ſurpriz'd to ſee how thick it was grown, for which reaſon, I ſet it by again, and made uſe of ſome other, and within three or four years, it acquired the conſiſtence of a thick Turpentine, as you may here obſerve. Hence, therefore, if Bodies are dipp'd into diſtill'd Oil of Turpentine, and are then hung up in a place where there is but very little Duſt, they will be cover'd over with a pellucid, reſinous Cruſt, within which they will be ſo excellently preſerved, that they will continue for a vaſt length of time uncorrupted.

3. By the method deſcrib'd then, the proper Spirits of Vegetables being freed from all the other parts, but retained by the tenacity of the vegetable Sulphur, may be kept a long time for valuable purpoſes, and in a ſmall compaſs be carried into other Countries with their Vertues intire. Thus, for inſtance, in a ſmall Bottle that will hold all the Oil of a hundred pounds of Cinnamon, we can collect and preſerve all its Vertues; ſo far, that is to ſay, as they depend upon its proper Spirit. And this ſeems to be the moſt natural method of collecting together the peculiar medicinal properties of Vegetables, in which they are very little altered or loſt, and by which, in particular, they may be ſecured for a great length of time. By this inſtance, therefore, conſidered in its proper extent, was there no other, the chemical Art wou'd ſufficiently recommend itſelf to the Phyſician.

4. As a great many of the eſſential Oils now are very valuable, there are not wanting Methods diſcover'd by the avaritious for their adulteration. In order to this, ſome Perſons mix pounded Almonds with the aromatic Subſtances to be diſtill'd, the Oil of which uniting with their eſſential Oil, increaſes the quantity: The ſame thing too others do with beaten Poppy-ſeeds. But others who are appriz'd that the choiceſt of theſe Oils may be perfectly diluted with Alcohol of Wine, and that they will by this means become ſtronger, mix this with them, and thus make a baſe profit by increaſing the quantity with ſomething of vaſtly leſs value; tho' it's true, it does not leſſen their vertues, but exalt them. The firſt of theſe cheats is diſcovered by mixing the Oil with hot Water, by which means the lighter Oil will be ſeparated from the heavy aromatic one, this ſinking to the bottom, whilſt that riſes to the top; as likewiſe by the admixture of the pureſt Alcohol, which will unite with the aromatic Oil, but reject the other inſipid one: The ſecond is found out by mixing cold Water with the Oil, for the Mixture will grow white, and the Oil and Alcohol be ſeparated, and diſcover nearly the quantity of Alcohol made uſe of in the adulteration.

PROCESS XXXV.

Vinegar, Spirits, a twofold Oil, a Reſin, and Colophony, procur'd from Turpentine by diſtillation in a Retort.

APPARATUS.

1. THAT the native Oils of Vegetables are neither ſimple, nor of a durable Nature, has appeared already; nay, from ſome Experiments we before explained to you the various Elements of which they conſiſt, or thoſe which by a Tranſmutation are produced from. We muſt now, therefore, take under Examination that Oil which ſpontaneouſly diſcharges itſelf, and is collected on the external parts of Vegetables under the name of a Balſam, or Turpentine. For this purpoſe, then, I take this clean new glaſs Retort, with a pretty large Neck, which I cut off in ſuch a manner, as to have the Mouth of it pretty wide, which is altogether neceſſary for this Operation; and into an earthen Pipkin that has a ſpout below the Rim of it, I put ſome very pure, native Turpentine, ſet it in Water that is almoſt boiling hot, and let it ſtand there till it is melted, and runs like Water, upon which I immediately pour it into the Retort, which muſt be made very hot likewiſe, that it may not fly with the heat of the Turpentine. In this manner I fill the Belly of the Retort two thirds full, and then, if in pouring it in, any of the Turpentine has lodged upon the ſides of the Neck, I hold the Retort with the Mouth upwards till it has all run down into the Belly, for otherwiſe this thick Turpentine in diſtillation would run into the Receiver, and mix itſelf with the Liquor that firſt riſes, and by this means prevent a nice examination of it. I then put the Retort into a Sand Furnace, and lute on a clean Receiver.

2. This being done, I raiſe ſuch a Fire as will give the Sand about 100 degrees of Heat, a little more or leſs, and this I carefully keep up as equably as poſſible, ſo long as any thing liquid continues to come over into the Receiver. By this means then I have a limpid, thin Liquor, like Water, which ſubſides to the bottom, and at the top of this another, which is ſubtile, thin, limpid, and oily. When nothing more comes off with this degree of Heat, I change the Receiver, and upon examination find the lower Liquor to be gratefully acid, ſaline, watery, miſcible with Water, ſpirituous, comforting to the Stomach, and a noble diuretic, and of ſuch a nature as to cauſe an effervеſcence with Chalk, at the ſame time depoſiting its acid part there, and then diſtilling into pure Water. Hence therefore an acid Salt and Water riſe firſt in this Diſtillation, together with the other Liquor that ſwims at top, which is a pure, light, thin, and almoſt ſpirituous inflammable Oil, called for this reaſon Ætherial Oil of Turpentine. And this is of ſo penetrating a nature, that if it is rubbed upon the external parts of the human Body, it will ſoon diſappear, inſinuate itſelf into the Blood, and in a ſhort time give the Urine a violet Smell, and thus ſufficiently evince its ſubtlety, and penetrability.

3. Luting on then a proper Receiver, let your Heat be increaſed to that of boiling Water, which is eaſily effected by pouring Water upon the Sand, and making ſuch a Fire underneath, as to give it and keep it in 212 degrees of

Heat, obſerving to put on continually ſo much boiling Water, as exhales in Vapour. The matter, by this means, that remain'd at the bottom of the Retort after the former diſtillation, and was ſo thick, that in the cold it would acquire a ſolid conſiſtence, will be melted again with a crackling ſinging noiſe, and will give out another acid Water, very much like the former, which will ſettle at the bottom, and another Oil that will ſwim upon it, exactly reſembling the preceding, except that it is a little thicker, and inclining to the yellow. With regard to their Vertues likewiſe, they are both very much of the ſame nature with the other.

4. If you then change the Receiver again, and give the *Reſiduum* a pretty ſtrong ſand Heat, increaſing it however very gradually, you will again have an acid Water at the bottom of the Receiver, which will be red, and heavier than the two former, and at top of this a thicker red Oil, ſtill conſiderably penetrating, tho' in ſome meaſure, however, tenacious. And here it is pretty remarkable, that this acid Water continues to come over as long as any of this Oil does, the Water not riſing firſt by itſelf, and the Oil afterwards. What remains, then, after the Diſtillation is over, is exceeding red, hard, and perfectly brittle.

5. This laſt *Reſiduum*, increaſing the Fire very gradually, and adding at the ſame time a ſuppreſſing Fire at top, I urg'd with the ſtrongeſt ſand Heat, and there was forced out an Oil as thick and tenacious as Turpentine itſelf, but of a red Colour, and with this ſomewhat ſtill of an acid, red, heavy Water. When this was done, there remain'd ſcarcely any thing in the bottom of the Retort.

6. And here give me leave to caution you, that the greateſt care is neceſſary in this Diſtillation that the Glaſs don't crack, for if this happens, there immediately exhales a thick oily Vapour, which eaſily takes fire, and then can ſcarcely be extinguiſh'd, but ruſhes into the Retort, and with a violent Flame and Exploſion burſts all to pieces, not without imminent danger to the Operator.

7. There is another method, likewiſe, which is commonly uſed for diſtilling Turpentine into an acid Water, an ætherial Oil, and a Spirit, as it is call'd, of Turpentine, and is as follows. The diſtilling Veſſel of the Furnace, deſcrib'd p. 512. Vol. I. is fill'd one third full of clean rain Water, into which is put half as much of the beſt Turpentine, and then the other part of the Still is fitted on with the Alembic, and you diſtill with a Worm and Refrigeratory, making no more Fire than what is juſt ſufficient to make the Water boil gently: By this means then, there will aſcend an acid Water, together with a light, pure Oil, and ſo long as any of this comes off, you muſt continue the Operation, which being compleated, you will have a kind of Colophony remaining in the Water in the Still. If during the Diſtillation you throw in ſome Roſes, Flowers of Lavender, or other Plants, you will by this means procure a fragrant Oil. In this Operation, therefore, the Turpentine is reſolved into a ſaline acid Spirit, a volatile Oil, and a more fix'd Colophony.

8. And here it is particularly remarkable, that the *Reſiduum* is always ſo much thicker, redder, harder, and more brittle, as there is more Water, Acid, and volatile Oil drawn from it; tho' even this laſt fix'd part, if it is urg'd with an intenſe Fire, will melt, and become volatile. This acid Water, now,

if it is perfectly freed from its Oil, and rectified, is perhaps one of the beſt vegetable Acids we are acquainted with.

USE.

1. HENCE we learn in what form native Oils are contained in Vegetables: For in the firſt place, the nutritious Juice, when it is firſt taken into the Plant from the Earth, appears to be nearly acidiſh and watery; which after it has entered its Veſſels in certain parts of the Plant, gradually depoſites its moſt pinguious Particles, which by a union with more of the ſame kind, heat, maturation, and the effect of the vertue of the whole Plant upon it, appear there in a pinguious oily Form: And this very ſame Liquid being afterwards propell'd outwards, and being farther acted upon by the ſame cauſes, acquires the name of a Balſam, conſiſting of Water, a ſaline, ſubpinguious, acid Spirit, and various Oils, conſiderably blended together, but ſtill capable of ſeparation; and when any one particular part is by any means ſeparated from the reſt, the Balſam is always changed to ſomething of a different nature from what it was of before. Hence then we ſee, what a vaſt difference there is in making uſe of a native Balſam in chirurgical and other medicinal Uſes, whilſt it is intire, and acts by all its Principles united together, and applying any of theſe by themſelves, after they are ſeparated from it. Certainly a native Balſam, diſſolved a little with ſome Yolk of Egg, is one of the nobleſt external Medicines the Surgeons are maſters of; as it is an excellent internal one too, for many Diſeaſes ſufficiently taken notice of by the Phyſicians. Nay, if it was only by the violet Smell which it gives to the Urine, it would ſufficiently diſcover its wonderful penetrating quality. The Balſams we have now-a-days, are ſcarcely ſo much different in their Vertues as they are in their price, and the places where they grow. The principal are, the *Balſamum Aſiaticum*, *Ægyptiacum Jeruchuntanum*, *Judaicum*, *Memphiticum*, *Opobalſamum*, which are all names for the ſame thing, and ſignify a Balſam of a white Colour, in a liquid form like Turpentine, and having a Smell reſembling that of a Citron: The *American*, which is of various ſorts and from different Trees; as the Balſam *Copaii*, *Capayaba*, *Capivi*, call'd *Moran*, of incomparable Vertues; Liquid-Amber; Balſam of Peru; Balſam of Tolu; *Mechaninn:* The true Turpentine of the *Chian* Turpentine Tree; the *Strasburg* from the Fir; the *Venetian* from the Larch-tree, and the Common from the Pine: All which by Heat, Diſtillation, and Time, are pretty nearly reſolved into the ſame Principles, undergo the ſame Alteration, and have the ſame Effects.

2. But hence we learn farther, likewiſe, that in all the Balſams hitherto known, there is an eager, acid, antiſeptic, penetrating Water, or Spirit, which is very fragrant, and endued with conſiderable medicinal Vertues, but eaſily exhales, and thus quitting the Balſam, leaves it in this reſpect leſs efficacious: Hence theſe are not the better for keeping.

3. The Oils that riſe firſt, which are light, limpid, totally inflammable, volatile, very penetrating, and bitter, are of excellent ſervice in Surgery; for theſe being pour'd warm, upon torn, prick'd, divided, or half divided Membranes, Nerves, or Tendons, are found incomparable Anodynes, Antiſpaſtics, and Conſolidants. In larger Hæmorrhages from wounded Arteries or Veins, they

prove the readieſt, and ſafeſt Styptic, having this particular excellence, that they at the ſame time guard the Nerves, prevent Putrefaction, and conſolidate the part. They muſt then be applied very hot, and be ſecured with a proper Bandage. Upon this head, you may conſult that *Engliſh* Author *Jacob Young*, who wrote a whole Treatiſe about it, called *Currus Triumphalis, e Teribintho*, printed at *London* in Octavo, 1679. And, indeed, the antiſeptic Vertue of this Oil is very remarkable; for if you let any animal Subſtances lie in it for ſome time, and then take them out and hang them a little in the Air, and repeat this ſeveral times, they at laſt will acquire a Cruſt, under which they may be kept a vaſt while, being intirely ſecured from Putrefaction. And thoſe Bodies, likewiſe, that are put into Veſſels, and covered with this Oil, become quite incorruptible. This one inconvenience, however, attends it, that it grows gradually opake, and thick. This warm Oil being rubb'd upon cold, mucous, viſcid Humours, often diſcuſſes them: It defends the parts too againſt Cold, and relaxes and ſoftens them. Internally it opens, warms, provokes Sweat and Urine, and gives this a violet Smell: Hence in the cold Fit of Intermittents it is a ſerviceable Medicine; nay, and by being rubbed upon the ſpine of the Back juſt before the Fit comes on, it does ſo much good, that even Quartans have been cur'd by it in this manner. It muſt be uſed internally, however, with moderation; for if it is taken in too great quantity, it affects the Head, cauſes Drought, and Pain, and urges the urinary parts ſo violently, that it raiſes a Diabetes, and provokes a diſcharge of the Liquor of the proſtate Glands, and the Seed; and hence if uſed moderately, it generally incites to Venery. On this account, it has got a name for curing virulent Gonorrhœas, in which certainly it often proves of dangerous conſequence, as the liberal uſe of it is apt to fire the genital Parts, and ſo increaſe the evil.

The Oils that are drawn off in this Diſtillation of a thicker Conſiſtence, are leſs penetrating than the former, but more balſamic, and conſolidating, ſooth the Nerves more when they are in pain, and are more emollient: Hence in Perſons of a warm diſpoſition, and prone to inflammations, inſtead of the thinner Oil theſe are made uſe of as Styptics; in other reſpects their vertues are the ſame. But the laſt thick, tenacious Oil, is the moſt beautiful conſolidant of all, incarning almoſt without ſuppuration, and being a moſt excellent Anodyne. This Oil will often cauſe ſuch an Efferveſcence with *Glauber*'s Spirit of Nitre, as to excite a Flame.

5. The *Reſiduum* of the Turpentine, after the Diſtillation with Water, or that which remains when you have drawn off the firſt Spirit and Oil in a Retort, is red, and in the cold will grow hard, pellucid, and brittle. If when this is melted, you carefully immerge an Inſect into it, and take it out again, it will have a clear Cruſt all over it, like Amber, within which it will be preſerv'd from corruption a vaſt while, and through which it will appear very elegantly, if the beauty of the poliſh is not injured, which will very eaſily happen, indeed, from the exceeding tenderneſs of this reſinous Cruſt. But if you take the Colophony that remains after the ſecond Diſtillation, this is ſtill harder, and redder, and will eaſily ſuffer itſelf to be reduc'd to a Powder, which has neither much Smell or Taſte. This is that noble Powder of ſo much ſervice when apply'd to Bones that are laid bare, or the *Perioſteum*, Tendons, and Muſcles, when they are burnt, corroded, bruiſed, prick'd, torn, or half

cut aſunder. This is an excellent Remedy likewiſe for ſerous Defluxions of the Joints, and moſt efficaciouſly helps to form a Citatrix; nor is it of leſs uſe in keeping down the fungous excreſcences of Ulcers. Hence, then, it appears, how very ſerviceable Turpentine is to the Surgeons. But in this whole affair, there is nothing more remarkable, than the ſucceſſive and ſpontaneous inſpiſſation of the firſt thin Oil again into the former conſiſtence of the Turpentine, then to that of a thicker Balſam, and at laſt to the ſolid one of a Reſin, with this circumſtance, however, always attending it, that there is leſs Acid in theſe regenerated Bodies, than there was in the native ones.

6. Is this native, volatile Acid, therefore, that reſides in this pinguious, oily Liquor, and Water, of the ſame nature with the aromatic Spirit of other eſſential Oils? Certainly, in theſe native pinguious Subſtances, it is contained and mix'd in ſuch a manner, that with the Water it lies conceal'd under one uniform Appearance: And hence native Balſams are converted into a true Oil, when this Water and Acid are ſeparated from them. And again, when the Water, Acid, and Oil are drawn off, a Balſam is turn'd into a Reſin. And this happens even in the external warm Air, for whilſt the Action of the Sun diſſipates the Acid, Water, and thin Oil, it is gradually inſpiſſated, till it at laſt puts on the form of a Reſin. Hence the ſame Bodies that are Oils in the Spring, in Winter become true Reſins, and in Autumn prove a proper pinguious Tegument for the Trees, to prevent their growing dry, and to ſecure them from the injuries of cold and froſt.

7. From this Operation, then, it evidently appears, 1. That the greateſt Heat of the Sun, apply'd for a conſiderable time, is capable of inſpiſſating liquid Oils through various degrees, till at laſt they are reduc'd to the ſolid form of a Reſin or Colophony. 2. That the heat of boiling Water acting upon theſe Oils, is able to effect the ſame thing in a ſhort time, forming a Colophony in the Still, within the ſpace of four or five hours, the Vapours that riſe in the mean time being an acid Water, a Spirit, and an Oil in great quantity. 3. That this Colophony being expoſed to a Heat of 280 degrees, is reſolv'd likewiſe into an acid Water, and a red, tenacious, heavy Oil, there then remaining a very hard Colophony, that is pellucid, of a blackiſh red Colour, and exceeding durable. And laſtly, that if even this is ſtrongly urged by the help of a ſuppreſſing Fire, kept up till the Glaſs is ready to melt, it will ſolely by the action of the Fire be totally converted into a liquid oily Matter, tenacious indeed, but truly liquid, and that, without any hard Colophony remaining behind. 5. Hence then we learn the tranſmutable Diſpoſition of the Oils of Vegetables, and the various effect of Fire acting upon them: For if it is applied to thin Oils in a certain degree, it inſpiſſates them into a hard, durable Maſs, which will always remain ſo; and yet if it acts upon this very Maſs in a greater degree, it will reduce it again to a liquid Oil, which likewiſe will always continue in that form, or at leaſt for a great length of time, and which by a repeated Diſtillation with a ſtrong Fire, will become perfectly liquid, and conſiderably thin: Hence then we ſee, that ſome Bodies owe their hardneſs to Fire, whilſt others are indebted to it for their fluidity.

PROCESS XXXVI.

Water, Vinegar, a fetid Spirit, and a Butter, drawn from that Balſam collected by the Bees, call'd Wax, by diſtilling it in a Retort.

APPARATUS.

1. SOME ſorts of Balſams being concocted and inſpiſſated by the Heat of the Sun, appear in very ſmall quantities on the Leaves of ſome Plants, as is evidently ſeen on thoſe of Roſemary: And there are others likewiſe which iſſue in exceeding fine Globules from the open ſeminal *Apices* of the male part of the Flower. Theſe it is ſcarce poſſible for us to collect by any Art whatever. But I remember once, when I was cohobating ſome Roſemary Leaves with Alcohol, I found, that the Spirits which were good before, had acquired a diſagreeable Smell and Taſte of Wax. I examined therefore the Leaves with a Microſcope, and I thought I evidently ſaw ſome little lumps of Wax upon their ſurface, and upon handling them a good deal, I found plainly that the Wax gradually gathered upon my Fingers. Wax therefore ſeems to be a *Species* of Turpentine, which the pinguious Juices of Plants when they are heated by the Sun diſcharge upon the ſurface, or which is generated in the *Capſulæ* of the *Apices* of the Flowers: This the Bees collect together, roll up into little Balls, diſpoſe upon their hind Legs, carry to their Hives, and form their Combs with, and this being afterwards ſeparated from the Honey, and freed from its impurities, ſerves for a great many uſes in human life. For the moſt part, it is of a yellow colour, and of a Smell and Taſte not diſagreeable: In extreme Cold it grows hard, and almoſt brittle; in Heat it grows ſoft and melts.

2. Take ſome of the beſt of this ſort of Wax, and cutting it ſo ſmall that it will eaſily go into the mouth of the Retort, fill it half full, and then fill up the remaining half with very pure Sand. Heat the Retort gradually, 'till the Wax is diſſolv'd, and has ſufficiently imbib'd the Sand, and then place it in a Sand Furnace, and lute on a Receiver.

2. Diſtill with a Fire gradually increaſed, and then there generally in the firſt place riſes a ſmall quantity of an acidiſh Water, that has a very diſagreeable, fetid Smell; and together with this, a Spirit.

3. When with a Heat of 214 degrees nothing more will come off, change your Receiver, increaſe your Fire, and there will gradually aſcend a thin Oil, which in the Receiver will harden like Butter, and be of a whitiſh colour. When this ceaſes to riſe, apply the ſtrongeſt ſuppreſſing Fire, and then the whole ſubſtance of the Wax will come over into the Receiver, where it will acquire the ſolid form of Butter, having changed the hard brittle diſpoſition of Wax for a ſoft pinguious one. The Sand is here added in ſo great a quantity in order to prevent the flatulent rarefaction that wou'd otherwiſe happen when the Wax came to boil.

USE.

HENCE then it is evident, that the whole Body of the Wax will become volatile in a certain degree of Heat, as appeared before in Turpentine, ſo that in this particular theſe both agree with Camphire, tho' this indeed is much more volatile than either of them. Wax now tho' it is totally inflammable, exiſts in a hard, and almoſt friable form. Nay when it is melted in hot Water, preſs'd through a Cloth, form'd into thin Cakes, and whiten'd by being expoſed to the Air, and Sun, and often ſprinkled with Water, even then the white Maſs may be intirely conſumed into Flame, and yet it is at the ſame time as brittle almoſt as Glaſs, and ſeems to reſemble nothing leſs than Oil. In what a variety of forms, therefore, do the inflammable Oils of Vegetables exiſt, *viz.* that of an Oil, Balſam, Reſin, Pitch, dry Tears, Wax and Butter; though here we ſee indeed that the Fire at laſt will produce liquid Oils out of what did not appear Oils before: This the preceding Diſtillation of Colophony, and the preſent of Wax moſt evidently evince. The Wax now when it is thus converted into Butter, does not recover again its former hard conſiſtence, for the Butter always remains ſoft, even in the extremeſt Cold. This I don't aſſert without ſufficient authority, for I diſtill'd myſelf ſome of this Butter from Wax, and kept it more than twenty Years in a cylindrical wide-mouth'd Glaſs, which was covered only with a Paper, and yet in all that time it was not returned to Wax, though we ſee that the exceeding liquid Oil of Turpentine will in a ſhort time be reduced to the thickneſs of a Turpentine. Don't you admire therefore the various action of Fire upon the oily parts of Vegetables? Certainly there can be no general rule laid down, with regard to its power upon them, that will always hold true. Camphire, we ſee, which is a perfectly pure inflammable Oil, riſes true Camphire in Diſtillation, and does not become a liquid Oil.

Butter of Wax, prepared in this manner, is an exceeding ſoft, anodyne, neurotic, emollient and relaxing Ointment, which excellently ſecures the Skin from being dried and chapp'd in the Winter, and does ſervice if it is rubb'd upon parts that are contracted: Sharp hæmorrhoidal pains too are greatly reliev'd by it.

PROCESS XXXVII.

Butter of Wax, by being diſtill'd again in a Retort, converted into a liquid Oil.

APPARATUS.

MELT Butter of Wax with a gentle Heat 'till it is perfectly diſſolved into a liquid Oil. Pour this melted Butter through a hot Funnel into a glaſs Retort, heated likewiſe, till you have fill'd it half full, taking all the care poſſible that none of it hangs to the ſides of the Neck of the Retort, for then it wou'd come thick into the Receiver, which we here endeavour to avoid. Place your Retort in a Sand Furnace, lute on a Receiver, and diſtill very cautiouſly, regulating your Fire in ſuch a manner, that there may be about the diſtance of ſix ſeconds betwixt the Drops. When you perceive that you have no more Drops with this degree of Heat, increaſe your Fire, and diſtill by the ſame rule; and this muſt be repeated, always increaſing your Fire with the ſame caution, as long as there remains any of the Butter in the Retort. By this means then the Butter will riſe, almoſt without any *Reſiduum*, and in the Receiver, inſtead of the Butter, you will have a thick Oil, very little leſſened in quantity. If this Oil of Wax, thus prepared by a ſecond Diſtillation, is diſtill'd again in the ſame manner, it grows liquider, ſofter, clearer, and thinner, ſo that at laſt it reſembles a limpid, ſubtil Oil. And here the oftener the Diſtillation is repeated, the ſofter and more mild the Oil grows, and yet at the ſame time the more penetrating.

USE.

HENCE then it appears that the action of Fire upon ſome oily ſubſtances of Vegetables, attenuates them continually more and more, nor gives them at the ſame time any degree of Acrimony, but on the contrary renders them conſtantly milder, and yet of a more penetrating nature. This laſt Oil of Wax is an incomparable remedy for any injuries of the *Papillæ Nervoſæ* of the external part of the *Cutis*; for in Chaps of the Lips, Nipples, or Hands, if it is gently rubb'd over now and then, there is hardly any thing that equals it. In diſcuſſing cold Humours too, that happen in the Face and Fingers in cold Weather, it is uſed with ſucceſs. And where the Tendons are contracted, and occaſion ſtiff Joints, this Oil, aſſiſted by Baths, Fomentation, and Motion, proves greatly ſerviceable in reſtoring them to their natural Flexibility. If it is rubb'd frequently upon the Belly, it relaxes the Bowels, and diſpoſes them to diſcharge their contents, and hence is an excellent Remedy in Diſeaſes of Children.

PROCESS XXXVIII.

Medicinal Elæoſacchara.

APPARATUS.

1. AFTER the Phyſicians had learned from the Chemiſts that the Spirit which reſides in eſſential Oils truly contains, in a ſmall compaſs, all the particular Vertues of Vegetables, they thought with a great deal of reaſon they were maſters of a noble Medicine; but which however had this inconvenience, that the natural make of the Oils made the uſe of 'em a little dangerous, as from their viſcidity they would be apt to adhere to particular parts, and being very acrid, would readily inflame them. They began therefore to think of ſome method by which they might be diſpoſed to be diluted with Water, and thus in a uniform mixture be conveyed without any inconvenience to the places they were deſigned for; and this they found might be effected by the help of Sugar, in the following manner. Take an ounce of the drieſt Loaf-Sugar, and in a glaſs Mortar, with a glaſs Peſtil, reduce it to an exceeding fine Powder,

into which drop gradually a Drachm of eſſential Oil, or, if it is very thick, half a Drachm, keeping it continually rubbing after every drop of Oil, till they are perfectly mixed, by which means the Oil will totally diſappear, being all abſorb'd by the Sugar. And here the Oil, during the Operation, will diffuſe a very fragrant Smell, for which reaſon it is proper to be as expeditious as poſſible, and keep the Mortar covered as cloſe as you can with a Cloth.

2. If during the rubbing, you add a little Yolk of a new-laid Egg, the Oil will be more eaſily reduced to a form fit for mixing with aqueous Liquids, but then it won't keep ſo long without growing rancid.

3. Thus then Sugar, which is a very pure *Sapo*, or a true eſſential oily Salt, deſtroys the pinguious tenacity of the Oil, interpoſes itſelf betwixt its Elements, and very cloſely unites them with itſelf, and thus produces an extemporaneous Soap, which ſuffers itſelf to be well enough diluted in Water for medicinal uſes. This indeed, it muſt be confeſs'd, won't mix ſo perfectly and intimately with Water as true Soap will, or as what the Chemiſts call a perfect eſſential Salt, tho' for common purpoſes it anſwers the end very well. Nor is there any ground to fear any inconvenience from the Sugar in this preparation, for though Sugar has got an ill name, as if it was prejudicial to the Health, this has never been ſufficiently proved. On the contrary, it is a wonderful Salt that is perfectly ſoluble in Water, nay and with Water will readily ferment and produce a Wine. In the mean time, however, which is pretty ſurprizing, if it is melted at the Fire, it diſcovers an oilyneſs which is perfectly inflammable, ſo that hence it appears to conſiſt of an Oil and a Salt.

4. If theſe *Elæoſacchara* are well prepared, and put pretty dry into glaſs Vials, and ſtopt nicely with glaſs Stopples, they may be kept for a long while without alteration. And thus, without any inconvenience of weight, you have a portable Medicine of excellent Vertues in a ſmall compaſs. And it has this great convenience in it, that you may at once, without any loſs of time, procure a noble medicinal Draught from it, by only mixing a little of it thoroughly with a glaſs of Wine. The ſame thing may be effected too by well rubbing a fixed alcaline Salt with an eſſential Oil; for by this means likewiſe you will have a Soap; but then the Alcali's take away the gratefulneſs of the eſſential Oils, by altering their proper Smell and Taſte: And then beſides, as they immediately diſſolve in the Air, they preſently change. Hence then the Phyſicians may compoſe a very beautiful and efficacious Medicine: For if an *Elæoſaccharum* made with Oil of Mint is diſſolved in its diſtill'd Water, and this is quickened with a proper quantity of its Spirit, and ſweeten'd with ſome of its Syrrup, in this Mixture, it is my opinion, you will have the proper Vertue of Mint.

USE.

HENCE then we ſee the ſaponaceous quality of Sugar, by which it is capable of breaking and dividing Oils in the ſame manner almoſt as if they were fermented with it; and yet at the ſame time, it does by no means diminiſh their particular Vertues, but rather improves and exalts them: The Ancients, who knew nothing of Sugar, mixed Honey with theſe Oils for the ſame purpoſes. But hence we ſee likewiſe the power of Sugar in the human

Body; for being diluted by the aqueous Juices it meets with there, it produces a ſaponaceous *Lixivium*, which being aſſiſted by the vital Powers, is capable of diſſolving viſcid, oily concretions; and hence it never generates any pituitous Matter, but actually divides and reſolves it when it is formed. Nor does it ever increaſe the quantity of Bile, or is converted into it, but it divides, attenuates and opens. In the mean time however, by too much diſſolving the Oils, it may make a perſon lean, as by attenuating too much it may bring on a weak, lax habit of Body; and hence to Ricketty Children, and Perſons troubled with the Scurvy, it has often been obſerved to do harm. This ſingular production now of Nature and Art, if we examine it, is of a pretty wonderful Nature, as I juſt now hinted; for it totally diſſolves in Water; it melts on the Fire; it ſhoots into perfect Cryſtals like the pureſt Salt; it is evidently oily; if it is diſtilled in a cloſe Veſſel, it yields an acid, penetrating Spirit; in an open Fire it is intirely inflammable; it will ferment, and is then converted into a very ſtrong Wine that will cauſe Drunkenneſs, and yield an Alcohol; and it will produce the ſharpeſt Vinegar. Theſe things conſidered then, is it a Salt? How comes it then to take fire and flame? Is it an Oil? How then can it cryſtallize? Is it an eſſential Salt? Why then will it ferment? Examine carefully, Gentlemen, the whole compaſs of Nature that we are at preſent acquainted with, and I am of opinion, you'll hardly find any other Body in which all theſe three circumſtances meet together.

PROCESS XXXIX.

Medicated Potions from Pr. 9, 10, 15-18, 23-31.

APPARATUS.

1. THIS Proceſs, as the preceding, is chiefly for the uſe of Phyſicians, and teaches how to apply the known Vertues of Plants to the human Body. Take then of any *Elæoſaccharum* one drachm, of *Tachenius*'s Salt carefully prepared two drachms, nor does it much ſignify from what Plant it is made, as there is ſo very ſmall a difference betwixt them. Rub theſe together for a good while in a glaſs Mortar, till they are accurately mixed, and then add ſix ounces of the cohobated diſtill'd Water of the ſame Plant the *Elæoſaccharum* was prepared from, and if the Syrup of the ſame is to be had in the Shops, it may be ſweetned with that likewiſe. By this means then you will have the Vertue of that Plant collected in a ſmall compaſs, which will act medicinally in the human Body, according to its proper nature. Nor is there any reaſon at all to be afraid, that the Salt will give it any other quality, for in our account of *Tachenius*'s Salt it appeared, that the particular quality of any Vegetable, with regard to its Salt, does not reſide in this Salt, but its proper eſſential Oil, whilſt the Salt is contained rather in a Matter common to others. If a Perſon therefore, in order to make ſuch a mixture from Cinnamon, ſhou'd take the pains to burn the Cinnamon, on purpoſe to mix the Salt with the Oil, he would certainly be at more trouble and charge than the goodneſs of the production would compenſate.

2. Thus then you have the concentrated Vertues of any particular Plant: For the elementary Water, which is contain'd in Plants, is intirely the ſame in all, and therefore makes no alteration in the Effect; and the Salt by being burnt loſes its proper quality, and acquires one nearly common to all, and conſequently from every Plant has much the ſame Operation: To the *Spiritus Rector*, which reſides in the Oil, and which you poſſeſs in this Mixture, are owing all the proper and peculiar Vertues. This therefore is a very convenient, uſeful, and efficacious preparation, if one firſt rightly knows the properties of any Plant, with reſpect to the human Body: For here you have a *Species*, tho' a leſs perfect one, of a ſaponaceous, oily, eſſential Salt of Plants, in which the famous *Helmont* placed almoſt all the efficacy of Medicines. If theſe Oils, according to that Author, are, by an occult Circulation, intimately united with their Salts into a compound form, you will then have a Liquor which is a *ſuccedaneum* to the *Alcaheſt*: But in theſe Mixtures you have a *ſuccedaneum* to this Liquor of *Helmont*.

USE.

THE Doſe of ſuch Medicines is determined particularly from the ſtrength of the Oil made uſe of. They are generally beſt taken upon an empty Stomach, reſpect, with regard to time, being had to the nature of the Diſtemper they are preſcrib'd for. Thus, for inſtance, if I would cure a ſimple Tertian that's very cold in the beginning of it, about two hours before the Fit is expected, I order the Patient to ſet his Legs and Thighs in hot Water, till he is moderately warm; then I give him half an ounce of a Mixture of the Water, Oil, and Salt of Wormwood every quarter of an hour, and take care he has his Legs and Thighs well rubb'd. This muſt be continued for the ſpace of two hours, and by this method almoſt all theſe Intermittents, even in old Perſons, are cur'd ſafely and conveniently, except there happens to be any thing ſchirrous in the caſe, or ſuppurated Matter. The ſame Mixture from Tanſy, taken upon an empty Stomach, is good againſt Worms; but here, inſtead of Salt of Tanſy, which is not ſo eaſy to be had, we ſubſtitute that of Wormwood. And thus in many other Diſtempers.

PROCESS XL.

Sweet-ſcented artificial Balſams, made with diſtill'd Oils (23---29) *Wax and Pomatum.*

APPARATUS.

1. OF the beſt Pomatum I take one Ounce, and in a *China* Cup melt it over a gentle clear Fire, and then gradually add a drachm of white Wax ſcraped very fine: When theſe are accurately mix'd together, I leave them till they begin to come to a conſiſtence, and then drop in one drop of an eſſential Oil, keeping them conſtantly ſtirring, that they may be thoroughly mix'd together. As ſoon as ever this is effected, I ſet the Cup in cold Water, that the Balſam by cooling preſently, may the better retain the Oil and Spirit. When

the Mixture is cold, it may be put up into tin or leaden Boxes that ſhut very cloſe, and ſo may be kept for years without ſpoiling. If inſtead of Oil and Wax, you take the expreſs'd Oil of Nutmegs, that is waſh'd till it is white, and has loſt all its Smell and Taſte, it will anſwer the ſame end; and this is the way indeed it is commonly made.

2. If a Perſon has a mind to make theſe Balſams of various and beautiful Colours, he may eaſily do it by mixing ſome pigment with them. Thus, for inſtance, if with an ounce of ſuch Balſam you mix a ſcruple of very fine powder'd Cochineal, it will be of an agreeable purple: If you add a little of the inſpiſſated Juice of Buckthorn-berries, your Balſam will be green: A little fine native Cinnabar will make it of a beautiful red; as Powder of Turmerick will give it a yellow Colour; and Smalt a blue one. Every Perſon, therefore, may make uſe of what pleaſes him beſt, ſo he don't add any thing that has a diſagreeable Smell, or will help to corrupt theſe pinguious ſubſtances.

USE.

AS theſe things are in great eſteem on account of the fragrance of their Smell, and are of ſervice to quicken and raiſe the Spirits when they are languid, it is proper to make them of the choicer ſorts of Oils, either alone, or artfully compounded together. Of this ſort particularly, are the Oils of the Peel of Sevil, and China Oranges, Cinnamon, Citron-peel, Cloves, Cedar, Jeſſamy, Lavender, Roſe-wood, yellow Sanders, white Lilies, Marjoram, Baum, Mace, Nutmegs, Origany, Roſes, the *Syringa*, Balſam of Peru, and Opobalſam, the two laſt of which are fragrant without Diſtillation. Other Oils too, that are eaſily to be had, are fit for making extemporaneous Balſams.

PROCESS XLI.

Any Meal, even that of corrupted Corn, call'd Malt, being diſtill'd with Water, yields an inert Water.

APPARATUS.

TAKE the Meal of any Corn whatever, and reduce it with clean Water to a thin Pap, and then in glaſs Veſſels diſtill it with a gentle Fire, taking care it contracts no *Empyreuma*, and there will come off an inſipid Water, which will contain nothing at all of inflammable Spirits. Or take the Meal of corrupted Corn, as *Tacitus* called it, or Malt, which we ſhall preſently deſcribe, and treat it in the ſame manner, and you will have a malkiſh Water as before, in which there will not be the leaſt appearance of any thing Acid, Alcaline, Oily, or Spirituous. And if you mix crude Meal and Malt together, the Event will be perfectly the ſame.

USE.

HENCE then it appears, that volatile inflammable Spirits do not actually exiſt in mealy Vegetables before they have undergone a fermentation, nor yet in that Matter, which has been prepared by that ſort of dry Fermentation by which Corn is made into Malt. Neither does the Nutritious part riſe in Diſtillation with the Water from freſh mealy ſubſtances; for if you examine the Vapour of this Water in the Alembic, you find it forms itſelf into a kind of dewey Drops, and does not run down in ſtreaks: If it is thrown upon Flame, it does not increaſe it, but extinguiſhes it: If it is drank, it is far from heating, or making a Perſon fuddled: And laſtly, it is neither capable of affording any refreſhment or nouriſhment. This Demonſtration now holds univerſally true in all ſorts of Corn and Pulſe whatever.

PROCESS XLII.

Honey diluted with Water into a Mulſa, *and then diſtill'd in the ſame manner, yields a Water that has nothing but the Smell of the Honey.*

APPARATUS.

I Take of the beſt native Honey 1 part, of pure Rain Water 6 parts, mix them well together, and diſtill them in Glaſs with a moderate Fire, and there riſes a Vapour, which fixes upon the Head in watery drops, and don't run down in *Striæ*, tho' you draw off two thirds of the Water you made uſe of. Nor has this Water the leſt vinous Smell, but only the proper one of Honey, in which there is frequently the fragrant Smell of the Flowers from which the Bees collected it. If any of this Water is thrown upon Flame, it does not ſupport it, but puts it out; and if you drink it, it has a malkiſh Taſte, nor heats or cauſes drunkenneſs.

USE.

HENCE then we ſee, that in this very concocted Liquor of Plants, which is generated and brought to perfection in their Flowers, and is afterwards collected by the Bees, there is not the leaſt appearance of any ſuch Spirit, as is afterwards produced by Fermentation. Whence it evidently follows, that the action of the Sun upon vegetable Juices, whilſt they remain in their proper Plants, is not able to affect them in ſuch a manner, as to excite in them a true Fermentation. Pure Honey, therefore, has no heating, drying, conſtringing quality, but on the contrary, an attenuating, deterging, relaxing, ſtimulating, ſaponaceous one. Hence for chirurgical and internal uſes, it is of excellent ſervice. And indeed among the ancient Phyſicians, you ſcarcely find any thing more recommended than this *Mulſa*, as they called it, of Honey and Water, inaſmuch as it attenuates, opens, ſtimulates, and purges, without exciting any heat. But this Water prepar'd from Honey with boiling Water, receives likewiſe ſome vertue from the Spirits of the Flowers from which the Honey was collected, which ſtill remain in it. And hence it makes admirable *Collyriums* and Fomentations for Eyes that are inflamed, or diſordered with Obſtructions; for it is in reality a kind of a Water of thoſe Flowers. What we have demonſtrated now of Honey, is equally true of any thick vegetable Juices that are freſh procured

cured from them, as Manna, Caſſia Pulp, Sugar, and Tamarinds, which being diluted with Water, and diſtilled in the ſame manner, yield no vinous Spirits. Nor do the thinner Juices of Berries, ripe Fruits, the Wood of the Birch, Vine, or the like, give out ſuch Spirits, if they are treated in the ſame manner when they are freſh ; ſo that the Demonſtration is univerſal.

Of FERMENTATION.

THERE is hardly any thing mention'd in Natural Hiſtory, which is of greater antiquity than Fermentation, nothing is commoner in Civil Life, nor does there occur any thing more frequently in the Chemical Art ; ſo that we may fairly ſay with the famous *Bellini*, all things are full of Ferments, particularly amongſt the Chemiſts. Nay, if you will believe *Van Helmont*, the proper vertue of Ferments alone, is the cauſe of all true Tranſmutations. But dealing too much in Generals, breeds confuſion; for if every Mutation is owing to Fermentation, then the word Fermentation will be as general as the word Mutation, by which means, the Names that belong to particular things are loſt. This confuſion, therefore, Men of Senſe have long complained of, and been deſirous that this affair might be ſet in a true light, which is what I ſhall now endeavour to do.

1. By the word Fermentation, then, I mean that inteſtine motion excited in Vegetables, by which they are changed in ſuch a manner, that the firſt thing that riſes from them in Diſtillation, is acrid, miſcible with Water, of a warm aromatic Taſte, inflammable like Oil, thin, and volatile ; or elſe, acrid, acid, that will extinguiſh Fire and Flame, and is leſs thin and volatile.

This definition, now, ſo limits the word Fermentation, that tho' it actually comprehends every thing that occurs in a true Fermentation, yet it won't ſuffer it to be apply'd to any thing elſe to which it don't properly belong. I ſay then, that in every Fermentation, there is an inteſtine motion of the whole Maſs, and all the parts, ſo long as this phyſical action continues ; and I call it an inteſtine one, becauſe it chiefly depends upon the internal principles of the vegetable Subſtances that are fermenting. I confeſs, indeed, that ſome degree of Heat is here neceſſary ; but ſtill this wou'd not excite a true Fermentation in the Matter, if it was not ſpontaneouſly diſpoſed to ferment. Take, for inſtance, Water, Spirits, Oil, or Salts, and expoſe them to the very ſame degree of Heat, and yet you will never bring them to a Fermentation. But I add farther, that this inteſtine motion can be excited only in vegetable Subſtances ; for as far as I have been able to inform myſelf, there never was one inſtance produced of a true Fermentation in animal ones, except when the Animals had juſt taken into their Bodies ſome vegetable Matter, which was not yet thoroughly concocted, and aſſimilated to the animal Nature ; nor has there ever been obſerved a proper fermenting motion in Foſſils. I know very well, that ſome famous Authors make no ſcruple to aſſert the contrary ; and therefore to diſtinguiſh here as nicely as poſſible, I define a true and perfect Fermentation by its proper effect, and that is, that it always terminates in the production either of the Spirit, or Acid, before deſcrib'd. To put an end therefore to this Diſpute, and ſet the affair at once in a clear light, I would only aſk the candid Chemiſts, whether this action of Vegetables, which I have thus deſcrib'd, ought to be call'd Fermentation?

mentation? Without diſpute they unanimouſly agree in it. If ſo, then, I aſk farther, whether therefore, for diſtinction ſake, and to prevent any farther confuſion upon this head, we ſhould not, according to the Rules of Art, call all thoſe Actions, which do not produce the Effect aſſign'd, by ſome other names? I think this evidently muſt be allowed to be the caſe. Putrefaction therefore in Vegetables, though it is a true inteſtine motion excited in them, yet, as for its proper and ultimate effect, it generates putrid Oils, and fetid, alcaline, volatile Salts, I abſolutely diſtinguiſh from Fermentation. Putrefaction too in the Humours of Animals, is a proper inteſtine Motion likewiſe, but then it never produces Acids or inflammable Spirits, but Phoſphorus's, and things of that nature, and conſequently is quite different from every Fermentation; for I cannot allow any thing to come under this name which don't either generate inflammable Spirits, or an Acid. For the ſame reaſon therefore all the various kinds of effervеſcences, which we ſhall hereafter explain, muſt be abſolutely excluded likewiſe, though theſe properly come under the title of inteſtine Motions, and are often obſerved even in pure, vegetable Subſtances, as we ſee in very ſtrong Vinegar, and a fixed alcaline Salt.

2. Every fermented vegetable Liquor, now, that in Diſtillation firſt gives out a Spirit that will burn, and may be mixed with Water, I ſhall diſtinguiſh by the name of Wine, whatever vegetable matter it is produced from. And this I think the manner of uſing this word will bear very well; for *Tacitus* uſes it not only for what is now commonly call'd Wine, but for Malt Liquor likewiſe, expreſly telling us, that the *Germans* made Wine from corrupted Corn, or what we now-a-days call Malt. All ſuch fermented Liquors therefore, whatever Vegetables they are prepared from, I ſhall call Wine, without any diſtinction. And again, every vegetable Liquor, that is fermented in ſuch a manner as in the firſt Diſtillation to yield an acid Liquor that will put out Fire, I ſhall call Vinegar; nor here again does it ſignify what Vegetable it is made from. The whole Effect therefore of a true Fermentation will be the production either, of Wine, or Vinegar.

3. A fermentable Body I ſhall call ſuch a one as by the action deſcribed, No. 1. may be ſo changed as to be capable of producing the Wine or Vinegar, deſcrib'd No. 2. As this now has never been obſerved to be the caſe in any Bodies but ſuch as are contained in the vegetable Kingdom, hence I muſt of conſequence allow nothing but Vegetables to be fermentable, though indeed it will hereafter appear that they are not all ſo.

4. By the word Ferment, I ſhall mean any Subſtance, that being intimately mixed with the fermentable Vegetables, No. 3. will excite, increaſe, and carry on the Fermentation deſcrib'd, No. 1. Hence therefore it appears at one view, that ſuch a Ferment muſt belong to the Claſs of Vegetables.

5. The fermentable Vegetables now, No. 3. are of very various ſorts: Theſe therefore muſt be divided into as many Claſſes as they require different methods of Fermentation, nor can we here with any propriety or convenience make more or leſs. Thus, as we muſt treat Rye in one manner to produce Wine from it, and the freſh expreſs'd Juice of Grapes in another; ſo it is abſolutely neceſſary to diſtinguiſh theſe two Vegetables into different Claſſes: But on the other hand, as Wheat, Barley, and Oats require the very ſame management as Rye for this purpoſe, hence, in this reſpect, there muſt be no

diſtinction made betwixt theſe, but they muſt be referr'd to the ſame. In the mean time, however, it is neceſſary to obſerve, that all Vegetables are not diſpoſed to ferment; for thoſe which we formerly deſcribed, Proceſs 33, as abounding naturally with a conſiderable quantity of an alcaline Salt, or as eaſily diſpoſed to yield ſuch a Salt, are unfit for Fermentation, tending on the contrary to Putrefaction. This formerly, whilſt I was but a Novice in theſe things, I experienced in Onions, and Turnips; for whilſt I was ſearching after a fermented Spirit from theſe, as a remedy for the Stone, I loſt my labour, for I obtained an alcaline, fetid, volatile Salt, with a Spirit of the ſame kind, inſtead of a true fermented Spirit. Hence therefore, though all fermentable Subſtances will undergo a Putrefaction, yet the converſe is by no means true, that therefore all that will putrify will ferment. In Vegetables therefore in this reſpect there is a vaſt difference, as you may ſee, Proceſs 32, 33.

6. Theſe things then being diſtinctly conſidered, to the firſt Claſs of Fermentables we ſhall refer all thoſe Seeds of Vegetables, which, when they are ripe and dry, ſuffer themſelves to be reduc'd to a fine Powder, and not into an oily Paſte; which Powder is called Meal. And here likewiſe I ſhall include thoſe Seeds, which though they abound with a pinguious Oil, yet may be ſo chang'd by Art, as to be converted into a Meal that is not ſo oily. Theſe mealy Fermentables now I am obliged to ſubdivide again into the three following ſorts.

1. The ripe Seeds of Culmiferous, Graminifolious, Spicated Plants, called Corn, as Oats, *Indian* Wheat, Graſs, Barley, Job's Tears, Millet, Rice, Canary-Graſs, and all ſorts of Wheat and Rye. To theſe likewiſe, on account of the affinity of their nature, may be added, Buck-Wheat and Flax; as alſo from their coming near 'em, the Seeds of all the Cucumber kind, as Citruls, Cucumbers, Goards, the Counter-Poiſon, Muſk-Melons, the Male Balſam Apple, Pompions, and the like. Under this head too we may likewiſe rank the Seeds of Lettice, or any other Plant of the ſame nature.
2. The Seeds of almoſt all the Leguminous, Podded Plants, with the Papilionaceous, or any other Flower, as Judas his Tree, Broom, *Spaniſh* Broom, Furz, *Crotolaria*, Dwarf-Broom, Crimſon Graſs Vetch, Shrub Trefoil, Stinking-Bean-Trefoil, Kidney Beans, Melilot, Trefoil, Fenugreek, Reſt-harrow, Medick-fodder, *Medicago*, The Nettle-Tree, Baſtard Acacia, Baſtard Sena, *Coronilla*, *Barba Jovis*, Peaſe, Everlaſting Peaſe, *Clymenum*, Tares, Lentils, Yellow Vetchlings, Beans, Goats Rue, Bitter Vetch, Liquorice, Saint-foin, Chiches, Ladies-fingers, Lupines, *Emerus*, Birds-foot, *French* Honey-ſuckle, Hatchet Vetch, Horſeſhoe Vetch, Scorpion-wort, *Aſtragalus*, Acacia, Caſſia, Sena.
3. Nuts that are not too oily, as all kinds of Almonds, Cheſnuts, Haſel-Nuts, Horſe Cheſnuts, Walnuts, Cocoa-nuts, and Piſtach Nuts; which, when they abound with too great a quantity of Oil, muſt by ſome method or other be deprived of it, which is beſt done by letting them begin to ſhoot, and then drying them.

7. The ſecond Claſs of Fermentables comprehends all the pulpous Fruits, as they are call'd, in which when they are ripe there is a large quantity of an acidiſh ſweet Juice. Of this kind are all Cherries, both ſorts of Gooſeberries, Mulberries, Raſberries, Elderberries of all kinds, all acidiſh Apples,

all Pears, Oranges, *Sevil* and *China*, Citrons, Lemons, Apricocks, Peaches, Plumbs, Medlars, and the like, provided they don't naturally tend to an alcaline fetid Putrefaction.

8. In the third Claſs are contained particularly, all ſucculent Herbs, and all their parts, as Flowers, Leaves, Roots and Stalks, if ſo be they are diſpoſed to grow acid, rather than putrid: Theſe therefore again may be collected from Proceſs 33.

9. The fourth Claſs contains the freſh, native Juices expreſs'd from Vegetables, their Fruits in particular, No. 7, 8. And hither we muſt refer likewiſe that thin Liquor that runs from Inciſions made in ſome Trees, as the Birch, Walnut, and Vine, particularly in the Spring ſeaſon: For almoſt all theſe Juices will ſpontaneouſly ferment, and then have their natural diſpoſition intirely altered from an acidiſh, ſtimulating, refrigerating one, to a heating, inebriating, vinous one. *Helmont*, the Father, recommended the Water that thus diſtills from the Birch, in the Month of *March*, as a ſecret for the Stone, that is to ſay, when it was freſh, or carefully kept without changing: And Mr. *Boyle*, from his own and other Perſons Experience, aſſerts its Vertues in this caſe ſtill more ſtrenuouſly; but he found, that though the freſh was of ſervice, yet it was quite of another nature when it had been fermented.

10. To the fifth Claſs again, belong thoſe vegetable Juices, which are generated, and thicken'd by nature into a ſaponaceous Subſtance of a ſaline and pinguious nature together. Of this ſort are Manna, Honey, Caſſia Pulp, Sugar, and all other things of this kind, that are not Balſamic, Gummy, Reſinous, or Oily.

11. Whether now to a ſixth Claſs we ſhou'd refer the Waters of Rivers, I am ſomewhat at a loſs. Theſe certainly ſeem to be common *Lixiviums*, impregnated with all kinds of Vegetables that fall into them, and are at laſt reſolved and intimately blended with them. And then thoſe that run through populous Cities have not only the freſh Liquors of Vegetables, but their fermented ones mix'd with them likewiſe. If theſe therefore are put up in Caſks, which were uſed for Malt Liquor, Wine, or Vinegar before, there may lie concealed in them a great quantity of Spirits, which may afterwards diſcover themſelves. And hence when they come under the Æquator, and into the torrid Zones, by being expoſed to ſo great a degree of Heat, they may be work'd up into a kind of Fermentation, Vol. I. p. 353, 354. To theſe ſix Claſſes then I think may be reduced all Bodies that are ſuſceptible of Fermentation, when they are manag'd after various manners according to their peculiar diſpoſitions.

12. In the Bodies now contain'd in the firſt five Claſſes, there are required ſome phyſical conditions to render them fitter for Fermentation, as

1. The moſt perfect maturity of them all in their kind: For all Seeds and Fruits, which are brought by Nature to ſuch Perfection, that if they are ſown in a good and proper Soil, and at the right Seaſon, they will produce a Plant fit for this Operation; whereas when they are crude, rough and watery, they are not ſo well diſpoſed for it. The rough Juice of unripe Grapes, or Crabs, is but little fit for Fermentation, though the expreſs'd Juice of them, when they are ripe, ferments ſpontaneouſly; and the caſe is nearly the ſame in others.

2. Some degree of Oilineſs is neceſſary likewiſe, but not too great a one; for very oily Subſtances grow rancid, rather than ferment, though at the ſame time thoſe will not ferment that have none. Hence very fat Almonds when they are pounded are leſs liable to be affected in this manner; and yet, if by the aſſiſtance of Water, they are properly reduced to a Milk, they are then diſpoſed to ferment; but moſt of all ſo when they are macerated in Water, and are juſt brought to ſhoot; for then their Oil being greatly leſſened renders them fit for this Operation.
3. But farther, they muſt not be too rough, and aſtringent; for ſuch Subſtances ferment with a great deal more difficulty: thus the Juice of Biſtort, Tormentils, and the like, can ſcarcely be raiſed to a Fermentation.
4. And laſtly, it is particularly requiſite in fermentable Subſtances, that they ſhou'd be capable of being diſſolv'd in Water: Hence Barks, Woods, and Roots, ſo long as they exiſt in theſe forms, will not be changed in this manner, though their expreſs'd Juice, being then miſcible with Water, will ferment very readily.

13. Ferments, now, or Bodies proper for promoting a Fermentation in others, are principally,

1. All ſuch Subſtances as are ſpontaneouſly very prone to Fermentation themſelves, and hence will ſoon ferment without the addition of any thing elſe. Of this kind in particular are the Juices of ripe Summer Fruits, which are ſo much diſpoſed to Fermentation, that they can ſcarcely be kept from it, except by adding ſomething to them of a contrary nature. Thus too Dough, made of Flower, work'd with Water, if it lies in a warm place, cannot be prevented from fermenting. Hence therefore we need not be ſollicitous about this firſt ſort of Ferment, as Nature every where ſupplies us with it abundantly.
2. The Yeaſt, or freſh Flowers of Malt Liquor, or Wine, which are thrown up to the top whilſt they are in the action of Fermentation; for if this light, frothy Matter is mix'd with other fermentable Subſtances it wonderfully promotes their Fermentation, provided theſe Flowers are freſh, and not fallen.
3. The ſame Matter, afterwards grown heavier, and ſubſided to the bottom, if it is not too old; for this likewiſe ſtill retains its former Vertue, tho' in a leſs degree than before: Thus we ſee, if the Lees, or Settling is ſhook up with its own Liquor, it often occaſions a new Fermentation, as it will with others likewiſe.
4. Caſſia, Manna, Honey, Sugar, and the like inſpiſſated Juices.
5. The acid, mealy, fermented Dough or Leaven of the Bakers. For if freſh, ſweet, wheaten Flower is kept in a dry place, and ſecured from Inſects, it may be preſerved for years without Corruption; but if this is kneaded with Water into a ſoft, ſtiff, ſweet Dough, and this is lightly cover'd in a warm place, it begins within the ſpace of an Hour to grow lighter, puff up, and be full of Bladders, and loſe its Smell, Taſte, and Tenacity, and afterwards acquires both a ſour Smell and Taſte, which was then called ζύμη, *Fermentum*, a Ferment, and gave the firſt name to the whole Operation; for if this Leaven is mixed with freſh Dough not yet fermented, it will make it ferment much ſooner, and more efficaciouſly than it wou'd do otherwiſe

otherwiſe. Hence then we ſee, that a Ferment may be ſoon prepared from a Body in which no Ferment actually exiſted before.

6. The *Reſiduum* of former fermented Liquors, with which wooden Caſks are ſometimes impregnated; for if theſe are thoroughly penetrated with the Wines that were in them before, they are diſpoſed to excite a much ſpeedier and briſker Fermentation in any freſh Liquors that are put into them.
7. Hither likewiſe is referr'd the beaten White of Eggs, which, though it does not ſo properly belong to the Claſs of Ferments, yet in ſome caſes may be admitted well enough. Thus, for inſtance, when the fermentable Liquors are ſo dilute and thin that they too eaſily diſcharge the Air and Spirits, which both excite and keep up the Fermentation, and conſequently don't retain them 'till they have chang'd the diſpoſition of the fermentable Matter, into that of a fermented one; then the Whites of Eggs being mix'd with them, by their tenacity, render them ſufficiently thick to inviſcate and ſecure the active Spirits for a convenient time. Theſe do not here therefore act properly as a Ferment, tending naturally themſelves to Putrefaction, but only aſſiſt the cauſes of Fermentation, by preventing their too ſpeedy Exhalation. The ſame thing therefore may be eaſily effected by other viſcid Subſtances likewiſe.
8. Some perſons too have added Salts, as well acid and auſtere, as alcaline. But this again is only in particular caſes, as the former. Thus, for example, when Subſtances to be fermented have ſo great a quantity of Acid in them as to impede their Fermentation, it is obſerved, that a prudent addition of a ſmall quantity of an alcaline Salt will render them more diſpos'd to it. And again, when there happens to be generated any thing ſubputrid in the fermentable Matter, then a proper addition of a little Acid will often reſtore again an aptitude in them for this Operation. Hence therefore it appears that though theſe are not Ferments themſelves, nay, not ſo much as Fermentables, yet, in ſome certain circumſtances, by removing the impediments to it, they become promoters of Fermentation. Tartar however, if it is good, may in ſome meaſure be rank'd amongſt Ferments.
9. And laſtly, it is obſerv'd, that the rougheſt Subſtances, by being mixed with Fermentables, will in ſome caſes too aſſiſt their Fermentation, though they very much hinder it in others. Hence Quinces, unripe Medlars, rough Cherries, and the like, have been referr'd too to the Claſs of Ferments. This however is only true when the fermentable Liquor is of itſelf too thin, and therefore wants an addition of ſomewhat rough, the better to keep in its volatile Spirits.

14. Having thus then diſpatch'd Ferments, let us now proceed to examine into the preparations which fermentable ſubſtances require to make them ferment more ſucceſsfully. Thoſe then that are comprehended under the firſt Claſs, require for this purpoſe a very particular management, for

1. Thoſe mealy Seeds, when they are thorough ripe and dry, are thrown, in warm weather, into Rain-Water that is catched in the Spring, in particular, and are there ſuffered to lie till they are ſwelled, and have taken in as much Water as they can: And this is called Maceration.

2. The Corn being thus ſoak'd, is taken out of the Water, and laid in large heaps in an open place where there is a moderate Wind blowing through. And by this means, in a ſhort time, there ſpontaneouſly ariſes in the heaps a pregnant warmth, by the aſſiſtance of which, the vital parts of the Seed are quickened and rendered active, and begin to ſhoot, by putting forth their ſeminal Leaves, and the rudiments of Roots. As ſoon as ever this is the caſe, there is a great deal of caution neceſſary, that the Corn by growing too hot, don't begin to putrify, and that by germinating too long, it don't conſume its mealy ſubſtance in ſhooting out into Leaves and Root; for the Fermentation that follows afterwards, is always ſo much the better, as this Germination is more nicely hit, a certain degree being neceſſary, but no more.

3. As ſoon as ever the Germination is ſufficiently advanced through the whole heap, the Corn muſt be immediately ſpread abroad, that by lying too thick, it mayn't acquire too great a degree of Heat, but may be cool'd and dry'd by the Wind's blowing through, a north Wind in particular. By this means, then, its ſhooting any farther is put a ſtop to, the mealy part being attenuated by the former Operation, but not conſumed. The Corn being thus prepared, it is gently thrown down a Pipe that is made very hot, which expeditiouſly dries it, and almoſt, but very ſlightly, torrifies it. This then is what *Tacitus* call'd corrupted Corn, and what now-a-days goes by the name of Malt. The principle alteration now that is induced upon the Corn by this management, is that its tenacity is ſo far hereby deſtroy'd, that tho' native Corn will not diſſolve in hot Water, yet this will eaſily ſuffer the greateſt part of its ſubſtance to be reſolved by it: For whereas crude Wheat, by being chewed, will be reduced to a tenacious ſubſtance, which can ſcarcely be attenuated by the moſt patient Manducation, yet this, when it is made into Malt, if you chew it, will be eaſily divided, and intirely diſſolv'd in the *Saliva.* But beſides, the Malt in making acquires a ſoft, ſweet Taſte, which was not in the Wheat before. When this Malt, now, is juſt going to be uſed, it is ground with a Mill into a Meal, which is then call'd ground Malt. And what I have here obſerv'd in this inſtance of Wheat, is found to be true of all the Seeds in the firſt Claſs of Fermentables. Thus if Beans are macerated till they are grown turgid, and are then thrown into a heap, and ſuffered to ſhoot, and afterwards dried expeditiouſly with a pretty ſtrong Heat, and then ground, they will yield the ſame *Phænomena. Phil. Tranſ.* No. 142. p. 1069. *Le Febre. Cap. de Ferm.*

15. The preparation of the ſecond Claſs of Fermentables, conſiſts, in the ſoft pulpous Fruits, in treading, preſſing, and pounding them, by which means their Juice is ſeparated from them with a conſiderable Froth. But if their ſubſtance is of a harder kind, they may then be boiled in Water, and afterwards reduced to a ſoft Pulp, as is often done with Apples and Pears. If they are pretty dry, they may be raſped with a proper inſtrument, and then be pounded with Water till they are brought to a Pulp, as in the Bulbs of *Jeruſalem* Artichoaks, *Virginia* Potatoes, and the like, in which there is not much tendency to Putrefaction; for if that is the caſe, then inſtead of fermenting, they will putrify.

16. Thoſe that belong to the third Claſs, are beat into a Pulp whilſt they are freſh and juicy, adding only a ſmall quantity of Water to make it of a thinner conſiſtence, and then they are ſufficiently prepared.

17. And as for the Bodies of the fourth and fifth Claſs, if they are of themſelves too thick, they muſt be diluted with ſuch a quantity of Water as will produce a Liquor that is capable of keeping up a new-laid Egg to its ſurface: But if on the other hand they are naturally too thin, then you muſt take them whilſt they are freſh, and before they have undergone the leaſt Fermentation, and by boiling them with a gentle Fire in a low broad Veſſel, inſpiſſate them till you have reduced them to a proper thickneſs; for otherwiſe they will ſcarcely ferment, or generate any good Spirits. Nor will the thick ones, without being diluted in the manner juſt mentioned, eaſily yield any fermented Spirits, but will readily degenerate into an Acid. Sugar that is dry, will keep in a very great Heat, without undergoing any alteration; but if it is reduced to the conſiſtence of Cream, it ferments violently, and is converted into a Liquor that plentifully abounds with Spirits. And the ſame thing is true in Honey, *&c.*

18. The next thing then to be conſidered, is the quantity of the Ferment that is neceſſary to be mixed with fermentable Subſtances, after they are properly prepared, that the Fermentation may proceed moſt ſucceſsfully. Here therefore we obſerve, that

The Preparations of the firſt Claſs reduced to Malt, in the Summer, ſcarcely require the aſſiſtance of any Ferment, but are of themſelves ſufficiently, nay often, too much diſpoſed to Fermentation. In Winter, however, the addition of ſome Ferment is neceſſary, as well as ſome artificial Heat, without which they would not be put into motion. And here the hotter you keep them, even in the Winter, the leſs quantity of Ferment there will be occaſion for. A little Yeaſt, about an ounce, for inſtance, to twenty pound, is ſufficient; or Honey or Sugar in the ſame proportion; or Baker's Leaven in double the quantity.

The ſecond Claſs of Fermentables ſcarce ever want the aſſiſtance of a Ferment, unleſs the Weather happens to be too cold, on which account, if the Fermentation proceeds too ſlow, you may add here too a little Yeaſt.

The third Claſs in Summer time, eſpecially if it is pretty warm, ferment of themſelves ſufficiently: In Winter, if the Fermentation is check'd, it may be promoted by the addition of Sugar, or Honey, as we explained before Paragraph 17.

Nor in the fourth Claſs are Ferments often neceſſary, for theſe Bodies too, if the weather is favourable, ferment ſo violently, that they can ſcarcely be kept within bounds; eſpecially if it is very hot, and the Fruits have had a fine Seaſon for ripening.

The fifth Claſs, likewiſe, does generally too without Ferments, they rather acting the part of Ferments themſelves. There is here therefore nothing more neceſſary, than to give them a proper degree of Heat, and keep it up equably. Hence, therefore, we ſee, that upon the whole, Ferments are not ſo neceſſary as is generally imagined.

19. Any fermentable ſubſtances whatever then, being thus prepared, and diluted with a ſufficient quantity of Water in the manner we have explained, let them be poured into an oaken Cask, in which a Liquor of the ſame kind

was fermented before, and which ſtill remains well ſoaked with it. Set the Veſſel by in a place where it ſhall be expoſed to betwixt 60 and 70 degrees of Heat, and let the Bung-hole be left open, that the Air may paſs freely in and out, or let it be gently covered with a bit of Flannel to prevent any Inſects falling into it.

20. I took here before you a glaſs Cucurbit, the biggeſt I could get, and placed it upright in a wooden Cheſt in ſuch a manner, that by putting a ſmall quantity of Fire at the bottom, I could keep it in an equable Heat. I then fill'd it with a crude fermentable Matter properly prepared for Fermentation, covering the Orifice ſlightly with a Flannel, and exciting a Heat but of betwixt 60 and 70 degrees, even in the Winter ſeaſon; and it was pleaſant to obſerve the *Phænomena* that followed, which in this way lie open to obſervation, always happen in the ſame manner, and make up the whole Hiſtory of Fermentation.

1. The Maſs then, which at firſt is at reſt, and is contained within a certain part of the Veſſel, begins to rarefy, ſwell, riſe up, and conceive an inteſtine motion through the whole, diſcovering itſelf by the various agitations of the Liquor, upwards, downwards, and in ſhort, in all directions, nor ceaſing, tho' the *Impetus* changes every moment. In the mean time there appear Bubbles generated in every part of the Maſs, which with a ſtrong tendency endeavour to aſcend, ſometimes burſting as they riſe, or elſe at the ſurface, with a hiſſing noiſe. Hence the whole Matter grows frothy, but the ſurface in particular, and with a noiſe, like that of Ebullition, there is diſcharged a ſharp Spirit, that ſtings the Noſe, is acidiſh, wonderfully elaſtic, nay incoercible, burſting aſunder almoſt all Veſſels in which it is contained, nor in theſe reſpects to be equalled by any thing elſe that I am acquainted with: Hence the great *Helmont* thought this ought to be diſtinguiſhed by a particular name, and therefore called it *Gas Sylveſtre*.
2. Whilſt theſe things proceed in this manner, the thicker part of the fermentable Maſs begins to be ſeparated from the thinner, and is thrown up to the top, where it is collected in a thick, ſpongy cruſt, which accurately covers the Liquid underneath, and confines and repels its more active parts, leſt they ſhould too eaſily exhale before they have performed their proper Office. And then it is very entertaining to ſee how great and conſtant an agitation there is through every the leaſt Particle of the liquider part that lies covered with this tenacious Cruſt. Certainly, we can ſcarcely conceive of a greater attrition than ariſes from the rapid agitation of theſe Corpuſcles among one another. And hence it comes to paſs, that the Cruſt being elevated and ſeparated by the exploſions that are continually happening, there frequently burſts out a Vapour through the Clefts with a conſiderable noiſe; upon which the Cruſt preſently cloſing again, confines, as before, the active principles, that they may not be too readily diſſipated. And indeed, the Formation, and Continuance of this Cruſt, tends above all things, to bring about a perfect Fermentation.
3. And whilſt theſe things happen, it farther appears, that whereas all the thick part of the fermentable Matter was at firſt carried up, and collected at the top, there are now ſome parts at the bottom of the Cruſt, which growing leſs rare, and being no longer kept up by thoſe Bubbles that rendered them light, begin to deſcend through the Liquid part, are agitated

upwards and downwards, form Bubbles about them, and by this means riſe, and then diſcharge them again and ſink, and when this has happened alternately in this manner for a good while, at laſt fall to the bottom, and remain at reſt. But at the ſame time, new little Maſſes of the ſame kind ſeparate from the Cruſt, and excite the ſame *Phænomena*; and when this has proceeded for ſome time, it often happens, that the whole upper Cruſt, now grown heavier, and leſs rare, on account of the Spirits it has diſcharged, ſinks down at once, and in a little while riſes up almoſt intire again, and that with ſuch an *Impetus*, as a Perſon can ſcarcely believe, that has not ſeen it. When the whole Cruſt now is perfectly conſumed and ſunk to the bottom, then the Fermentation ceaſes, tho' the ſame degree of Heat is ſtill continued; and then a clear, thin, light Liquor ſwims at top, and the *Fæces*, Lees, or Grounds lie at the bottom.

4. Hence in every true Fermentation, the fermentable Matter is firſt equably mixed together, and then is ſeparated into two parts, a Liquider underneath, and a thicker Cruſt at top. This Cruſt, ſo long as it continues there, is called the Flowers of the fermentable Liquor, or Yeaſt, and of all Ferments, is the moſt convenient, and quick in its effect. But again, in the ſecond ſtage of Fermentation, it is ſeparated into three parts, *viz.* the Flowers at top, the Liquor underneath, and a third part, which begins to fall and be collected at the bottom, under the title of the *Fæces*, which are thicker and heavier, and are then quite exhauſted of that principle which cauſes the Fermentation. And laſtly, in the third ſtage, it is again divided into two parts, the upper of which is clear, fine, and thin, and is then called Wine, whilſt the other which is thick, and lies at the bottom, is called the Lees or Mother of the Wine.

5. But there is nothing more ſurprizing here, and that better deſerves taking notice of in this affair of Fermentation, than that prodigious *Spiritus Sylveſtris*, which ruſhes out with ſuch an *Impetus*, when the Fermentation is at the height; nor is there any Poiſon that I am acquainted with, that is ſo ſubtle, ſwift, and fatal: For if a very large Veſſel full of Muſt, in the very act of Fermentation, ſhould diſcharge this Spirit through a ſmall vent-hole in the upper part of it, and the ſtouteſt Man ſhould apply his Noſe to this Hole, and at once draw in this Vapour, he would drop down dead in an inſtant, without any apparent cauſe of it. If a Perſon only takes in a little, he falls into an Apoplexy; if ſtill leſs, he is either deprived of his Underſtanding, and the remaining part of his Life is a perfect Changeling, or elſe becomes Paralytic. And hence the ſame things happen to thoſe Perſons who are a great deal in Wine-vaults, where the Wines are fermenting in the time of Vintage, eſpecially when they are very cloſe. For this reaſon, therefore, theſe places ought to be purified by Fires, and ſetting the Windows open, that the Air may draw through. From Sugar diſſolved in Water, and then fermented with its Spume, we have an account of a Spirit produced, which being drawn into the Lungs, only in a ſmall quantity, in an inſtant ſtopp'd all Reſpiration, exciting an intolerable Aſthma. *Phil. Tranſ. Ab.* Vol. II. p. 635. Hence, therefore, Phyſicians may learn, what a powerful effect Liquor may have that is drank in the very act of Fermentation; and how violent that Spirit may be which is generated

rated in hot weather in the human Body, from large quantities of very ripe Fruits, eſpecially if by a convulſive conſtriction of the Stomach they are prevented from paſſing any farther, and hence, by being kept warm there, acquire a prodigious elaſticity, and acrimony. In Alcohol now, there ſtill remains a good deal of this Poiſon, and hence if the Vapour of it is taken into the Noſe in a great quantity, and for a long time, it cauſes the greateſt degree of Drunkenneſs, or a ſlight Apoplexy: If it is uſed too freely internally, it affects the Brain and Nerves, particularly, and their functions. In Chemiſtry, however, we are ſtill at a loſs from whence ariſes this Spirit. We know, indeed, it is the production of an actual vigorous Fermentation; nor do we know that ſuch a one is generated in any other way: But ſtill we cannot by any means conceive how it can in an inſtant cauſe death, without any intervening diſorder of the *Cerebrum*, *Cerebellum*, or Nerves, almoſt without any matter, or without any viſible alteration, either in the Solids or Fluids. But to return, as ſoon as ever the Fermentation is over, it is proper to cloſe the Veſſel, and let the fermented Liquor ſtand for ſome time upon its *Fæces*, or Mother, for this Liquor will ſtill conſume a good deal of them, and aſſimilate them to itſelf, and by this means becomes ſtronger, and more ſpirituous, and ſo more fit for Diſtillation.

21. The time neceſſary for compleating a perfect Fermentation, can't poſſibly be determined exactly, as this depends upon the place where the Veſſel ſtands, the Seaſon of the year, the Heat, and Wind it is expoſed to, and the nature of the fermentable Matter itſelf. In *Africa*, the Liquor of the Palm-tree finiſhes this Operation in the ſpace of a few hours. In *Aſia* too it is very ſoon over: But in the northern countries it proceeds more ſlowly. Hot weather forwards it, and ſhortens the time of its duration; Cold checks it, and protracts it. With a South Wind too it goes on more ſucceſsfully than with a North Wind, which is ſome impediment to it. The expreſs'd Juice of Grapes and Sugar ferment in a ſhort time, and very violently; other fermentables work more ſlowly. But tho' it is impoſſible to aſcertain any time for this Operation, yet it is eaſy to know when a perfect Fermentation is at an end, *viz.* when all the *Phænomena* mentioned have appeared in the order deſcribed, and at laſt ceaſe ſpontaneouſly: And then the Veſſel muſt be immediately ſtopp'd, and the fermentated Liquor muſt be kept upon its Lees; for otherwiſe the Spirit generated by the Fermentation, would in a ſhort time exhale, and leave the fermented Liquor vapid, and good for nothing; whereas if the Liquor is kept quiet in a Veſſel well ſtopped, it grows gradually finer, more ſubtil, and fuller of Spirits. Thus the freſh expreſs'd Juice of Grapes, may, by boiling, be inſpiſſated without loſing any of its vertue, and yet when it is fermented, if it is expoſed to but a cold Air, it is ſoon exhauſted of all its Spirits.

23. The Liquor that is thus prepared by a compleat Fermentation, has in all Ages, amongſt all Nations, and in every Language been called by the ſame name, Wine; the proper nature of which is diſtinguiſhed by the following marks which are common to every ſort of it.

1. In the firſt place, it is capable of producing a diſorder in the function of the animal Spirits and Powers. And this it generally brings about in the following manner: Firſt, it refreſhes, exhilarates, raiſes the

Spirits, makes a Man merry, and diſpoſes him for the gayer Diverſions of Singing, Dancing, and the like; it then affects his proper and prevaling Paſſions, diſcovers them particularly, and makes him ſpeak his mind freely; afterwards it diſorders both his internal and external Senſes, and diſturbs, weakens, and at laſt takes away voluntary Motion, ſo that neither the Foot, Hand, nor Tongue, can perform their Office; and then follow Sleep, Palſies, Apoplexies, and often Death itſelf. This now is the peculiar Property of Wine, nor is there any thing like it in any other Body that I am acquainted with: Henbane, Tobacco, Opium, and the Thorn-Apple, whilſt they affect the Brain act in quite a different manner. And this Vertue is nearly the ſame in every ſort of Wine; for Malt Liquor, Mead, Cyder, Perry, and Wine made with Gooſeberries, Grapes, or any ſort of Berries, has always the ſame effect: So that this ſurprizing Power is ſolely the effect of Fermentation.

2. But Fermentation likewiſe changes vegetable Juices from their relaxing, reſolving, ſaponacious, refrigerating, and, for the moſt part, purging quality, into one that corroborates, thickens the Humour, dries, and heats. Examine, for example, any mealy Subſtances reduc'd with Water to a crude Pap, the inſpiſſated freſh infuſion of Malt, before it is fermented into Beer, a *Mulſa* of Honey and Water, Syrups made with Sugar, Manna, or Caſſia Pulp, diluted with Water, the freſh expreſs'd Juices of very ripe Fruits, and freſh fermentable Herbs when they are at their maturity, I ſay, conſider all theſe, and don't they, if they are taken in too great quantities, produce windy diſorders in the Bowels, excite a *Diarrhœa*, and make a Perſon chill? And yet when they are properly fermented, and rightly made into Malt Liquor, Mead, and Wine, how very different are their powers and effects? Certainly they retain nothing of their former diſpoſition. The rich Juice of very ripe Grapes is perhaps the moſt powerful Diſſolvent of the Humours we are acquainted with, and if us'd immoderately, often bring on a fatal Dyſentery; and an infuſion of Malt inſpiſſated by boiling, drank plentifully, has the ſame effect; and yet ſtrong old Wine from the former, or generous old Malt Liquor from the latter, or the diſtill'd Spirit from either of them, but particularly Alcohol, is a good Antidote againſt 'em.

3. But another perfectly ſingular Property of Fermentation is this, that from the fermented Matter it generates a Liquor, call'd a fermented Spirit, which has this particular quality, that it is convertible into a lucid Flame, and at the ſame time will bear to be mix'd with Water, and which is quite of a different nature from the *Spiritus Sylveſtris* before deſcrib'd, which ſeems to be produc'd in the very act of Fermentation, and is then too diſſipated into the Air. This Liquor now ſeems not to have any thing like it in all Nature: For the volatile, inflammable Spirit, which I once ſaw in a very dangerous manner burſt out of the Retort in the diſtillation of Phoſphorus, wou'd not be diluted, and extinguiſhed with Water: And as for the Vapour which ariſes from large quantities of human Excrements thoroughly putrified in a cloſe place, and takes fire, and burſts into a violent Flame upon the application of a Candle, that ſeems to be of the ſame nature, but horribly fetid: Oily Subſtances too, when they are

urged with the laſt degree of Fire in diſtillation, ſend forth bluiſh white Fumes, which upon holding a lighted Match to them will take Fire, but then theſe are reducible to Oils, or a Phoſphorus, that won't mix with Water. Upon a careful Examination, therefore, I have not been able to diſcover any Liquor, which wou'd abſolutely, and ſpontaneouſly, as it were, mix with Water, and yet at the ſame time might be converted into a pure Flame, except that which is produc'd by the Fermentation we have been deſcribing.

4. Another proper effect of Fermentation is the generation of the Wine Stone, call'd Tartar, as was explained before, Proceſs 8. I confeſs indeed, that this is not produc'd from all *Species* of Wine; for it is neither found in the beſt Malt Liquor, Mead, nor many other ſorts. From ſome Vegetables, however, this is form'd good and pure, but then only when they have been made into a Wine by a proper Fermentation, and are grown very fine. Hence, therefore, I always look upon Tartar as a peculiar production of Fermentation, and think it ſhou'd be call'd the Eſſential Oily Salt of the Wine, and be abſolutely diſtinguiſhed from the Mother or Lees.

5. But Fermentation, farther, always produces a ſurprizing alteration in the Smell, Taſte, Nature, Qualities, and medicinal Vertues of Vegetables. By comparing the ſixteenth and ſeventeenth Proceſſes together, this has already appear'd very evidently; for the cohobated Water of freſh Roſemary differ'd intirely in every property from that which was drawn from it after it had been firſt fermented with Honey. The Muſt juſt preſs'd from the ripe *Rheniſh* Grapes that lie expoſed to the Sun upon the ſides of Mountains, is of an exceeding ſweet Taſte, and yet when the Fermentation of it is compleated, and it is grown fine in its Caſk, it is gratefully acid. Other Wines that are not thoroughly fermented, but have their Fermentation ſtopp'd before it is perfectly finiſh'd, remain ſweet indeed, but then they very eaſily fall into a Fermentation again, and when it is over become acidiſh. And that Aloes and Colocynth, by Fermentation, loſe their Bitterneſs, we have an account by *Wedelius*, *Act. Lipſ.* 1686. p. 366. I have here too ſet before you very pure Spirits prepared from Malt Liquor, Mead, Cyder, Wheat, and Grapes, nor do I imagine you will diſcover any difference betwixt 'em.

6. Again, Fermentation produces that new Smell, Taſte, and Vertue, which is properly called Vinous. And here there is ſomewhat nearly acidiſh, warm, and oily, even from Meal, Sugar, and Honey.

7. And Fermentation only generates the Spirits abovemention'd, either from a Matter that was before abſolutely of another nature, or from the Oil of the Plant. This laſt opinion indeed I think ſeems very probable. But then from which of the Oils have they their Origin? Almoſt all the Chemiſts ſay from their Eſſential Oil. But by what Experiment they are able to determine this I own I cannot comprehend; for the *Spiritus Rector* which forms the Eſſential Oil is loſt by Fermentation. In a fermented Liquor too, depriv'd of its Spirit by Fermentation, there remains a good deal of Oil; and yet I cou'd never excite a new Fermentation in this *Reſiduum*, nor by any art extract any more ſuch Spirits from it. In every fermentable Subſtance

therefore there is naturally only a certain part which is diſpos'd for the generation of Spirits, nor can more than one determin'd quantity be procur'd from them by Fermentation, let it be aſſiſted by any contrivance whatſoever. But there is yet another thing too which deſerves conſideration, and that is, that the fineſt, and moſt thoroughly fermented Wine generates white Tartar, which is full of a perfectly inflammable and exceeding penetrating Oil, and yet you can by no Chemical Operation produce inflammable Spirits from this, though you can from the Wine in ſuch great abundance. Hence then you ſee, Gentlemen, that the Matter which is convertible into theſe Spirits by Fermentation is of a perfectly ſingular nature. But as Fermentations of one kind or another, which properly generate theſe Spirits, are always going on in all parts of the World, there muſt of conſequence be a vaſt quantity of theſe Spirits produc'd, which are either conſum'd by Animals, or diſſipated into the Air. The *Saliva*, Blood, and Urine, however, of thoſe perſons who conſtantly drink freely of theſe Spirits every Day ſcarcely afford any Spirits in Diſtillation; but then, it's true, there is never wanting in Nature proper Matter for producing more, let but Fermentation come in to its aſſiſtance. Think of theſe things, Gentlemen, and you will find here a new ſubject to examine into, worthy your penetration. But Fermentation generates ſomething ſaline likewiſe; for the Acid produc'd here is conſiderably volatile, though leſs ſo indeed than the Spirit. Thus from Vinegar there riſes a volatile, acid, ſubpinguious Salt, which the Subſtance did not afford before it was fermented. Nay even the Spirits themſelves that are generated by Fermentation, have ſomewhat in 'em of this volatile Acid. Hence the Oils and acid Salts of fermentable Bodies ſeem to be attenuated, render'd volatile, and united together by Fermentation, and to be conſum'd in a certain quantity. Thus if I diſtill unfermented Roſemary with Water, I have an Oil which has the true Smell and Taſte of the Roſemary, and a milky Water impregnated with the ſame Qualities: If I ferment it with Honey too, and then diſtill it before the Fermentation is quite compleat, I procure likewiſe a white, thick, opake, diſtill'd Water, which poſſeſſes abundantly the Vertues of the Roſemary, together with ſome Oil ſwimming at top, though in a ſmaller quantity than before: But if I ſuffer it to be abſolutely fermented, and then commit it to Diſtillation, I draw off a pellucid Spirit of Roſemary, that will mix with Water, and is endued with excellent medicinal Vertues; but the former Eſſential Oil appears no longer.

8. This Spirit produc'd by Fermentation, which partakes of the Oil, becomes by this Operation more volatile than Water; whereas the Eſſential Oil, before the Operation, was not ſo volatile, as the Vegetable might, by a gentle Heat, be depriv'd of all its Water, without any Oil's aſcending with it.

23. The circumſtances now neceſſary to a ſucceſsful Fermentation are principally theſe:

1. It is requiſite that the fermenting Liquor ſhould ſtand quiet, that the Cruſt which forms itſelf at top may remain intire; for whoever is continually

breaking this, and mixing it with the Liquor underneath, will be diſappointed if he expects a perfect Fermentation.

2. There muſt be a free admiſſion of the common Air, which muſt be intimately mixed too with the fermentable Matter, by treading, kneading, or preſſing: If this is kept out, the Fermentation will not proceed.
3. Such a degree of Heat too is neceſſary as was before deſcribed, *viz.* betwixt perhaps 40 and 80 degrees the outſide.
4. And laſtly it is obſerved, that the Spring and Autumn in particular, favour this Operation, when thoſe Vegetables are in Flower, from which the Wine was made: Hence the Wine of Grapes is ſaid to grow foul, and eaſily ferment again, when the Vine is in Bloſſom.

24. The checks to Fermentation, by which it is either impeded after it is begun, or quite put a ſtop to, are chiefly as follow.

1. The acid Vapour of burning Sulphur included in a conſiderable quantity, with that Air which is in the Cask above the fermenting Liquor: For if you take a Cask, and thoroughly penetrate and fill it with this Vapour, and then putting your fermenting Liquor into it, fill the upper empty part as full as you can of this Vapour likewiſe, and carefully ſtop it in, you will prevent any farther Fermentation; which, however, after being at reſt ſome time, may be reviv'd again by its proper cauſes, and reſtrained by the ſame Fumes. The ſame thing too is effected by mixing a large quantity of a ſtrong Acid with the fermenting Matter: The Acids of Alum, Nitre, Salt, Sulphur, and Vitriol, have this property, but at the ſame time they ſpoil the Liquors.
2. Alcaline Salts too, if they are mixed in great quantity with fermenting Liquors, excite for the preſent a very conſiderable Effervescence, but that ſoon ceaſing, the Liquor is preſently at reſt, its proper nature being ſo deſtroyed, that it can ſcarcely be afterwards raiſed to a Fermentation, but will rather be diſpoſed to putrify. Hence it appears, that alcaline Subſtances are a greater obſtacle to Fermentation than Acid ones, the former deſtroying or ſuffocating all the Acid. And for this reaſon,
3. All thoſe Bodies which will intirely abſorb acids, if they are mix'd with fermenting Liquors in a proper quantity, after a ſhort ſtruggle and effervescence, put a ſtop to this Operation: Chalk, Crabs-eyes, Corals, Pearls, Oyſter-ſhells, Iron, Lead, and Tin, have this effect.
4. The ſtopping up the Veſſel ſo cloſely, that nothing can poſſibly paſs in and out, provided the Veſſel is ſo ſtrong that it won't be burſt by the force of the included Liquor. This is evident in new Ale put into very ſtrong Bottles, which afterwards, when it comes to have Air let in upon it, converts the Fermentation, ſo long ſuffocated, and prevented, into the moſt violent Effervescence, and diſcovers a prodigious collected Power. The ſame thing is found true in Casks likewiſe; for there is always a conſtant action and re-action betwixt the containing Veſſel, and the contained Liquor.
5. A great degree of Cold too, puts an end to Fermentation intirely; for under 36 degrees of Heat it will ſcarcely ever be carried on.
6. Nor is too much Heat a leſs obſtacle to it, which if it exceeds 90 degrees, diſſipates rather the active principles of Fermentables, than aſſiſts and

quickens them. Hence an exhalation performed with a greater degree of Heat than this, inſpiſſates Fluids to ſuch a degree, as renders them abſolutely unfit for Fermentation. And boiling has the ſame effect a great deal ſooner, ſo that the richeſt Juice of Grapes, which can ſcarcely be kept from fermenting, will, by being briskly boiled, loſe all its diſpoſition to ferment, and be converted into a Maſs that will afterwards remain quiet for years without alteration.

7. The ſeparation of the elaſtic Air by means of *Boyle*'s Air-pump, during the abſence of which, this fermentative motion intirely ceaſes.
8. And laſtly, a very great condenſation of the ſame Air with the fermentable Matter, abſolutely prevents both the Beginning and Progreſs of Fermentation.

25. After Liquors thoroughly fermented, have been kept ſome time in a cool place together with their Flowers, and *Fæces*, and in Veſſels well ſtopt, and pretty full, and by this means have got more Spirits, if you have a mind to diſtill them, it is proper to ſtir them about and mix them with their Lees, for they will then give out their Spirits in greater abundance. But then, however, it is neceſſary to take care that the Grounds don't fall to the bottom of the Still, and by being burnt there, give the whole Liquor an empyreumatical Smell and Taſte: For this reaſon, therefore, the Liquor muſt be kept ſtirring with a Stick till it is ready to boil, by which means the thicker parts being kept conſtantly mixed with the thinner, they will afterwards by the motion of this great Heat be eaſily kept ſo. In this manner then you will be able to procure the Spirits, as well from the *Fæces* as the Liquor itſelf, and will in the beſt manner provide againſt an *Empyreuma*. And here I may add, that if the Fermentation has been over ſome time before the Diſtillation, there is leſs danger of the Liquor's rarefying and riſing out of the Still; whereas if you diſtill when they are juſt fermented, the *Impetus* of Fermentation that ſtill remains, will often carry up the Liquor when it comes to boil violently, and ſo diſturb the whole Operation. At the beginning, therefore, it is neceſſary to proceed with caution. But

26. An *Empyreuma* is particularly prevented,

1. By rubbing the bottom and ſides of the Still with ſome pinguious oily Matter, before the Liquor to be diſtill'd is poured in.
2. By keeping it conſtantly ſtirring till the thick part begins to be mixed by the Heat, and ſo is prevented from collecting and ſticking to the bottom.
3. By firſt boiling ſome Water briskly in the Still, and whilſt it continues in that condition, at once flinging in your Liquor; for then the hot Vapour filling the cavity of the Still, will hinder the fermented Liquor's fixing to the ſides.

27. If now, as I hinted before, the whole fermented Matter, *viz.* the top or head, middle Liquor, and bottom or mother, are accurately mix'd together before they are diſtill'd, you will have a larger quantity of good Spirits.

28. When your Liquor then is heated to ſuch a degree, as to be juſt ready to boil, you muſt beware of the firſt *Impetus:* This is beſt guarded againſt, by leaving the Still one third empty, and covering the Aperture of the Still with a thin Cloth, before you fix on the Head, and then managing the Fire in ſuch a manner, that the Drops ſhall only fall preſently after one another. In this

manner then, your Diſtillation may be performed ſafely, and after it is thus continued for ſome time, it may be cautiouſly increaſed, by which means it will moſt ſucceſsfully ſeparate all the Spirits. The thinner, clearer Liquors, however, as Mead, Wine, and old malt Liquor, don't require ſo much caution; but in mealy Subſtances, diſtill'd after a perfect Fermentation, you can't be too careful. The former, therefore, you may at once venture to diſtill in ſuch a manner, that the Spirits ſhall almoſt run through the Worm in a full Stream.

29. The Diſtillation of fermented Bodies then being managed in the manner deſcribed, there firſt comes off a Liquor, which is acrid, heating, and pungent, and has a very particular penetrating Taſte, called a ſpirituous one: In its nature too, it is exceedingly active and volatile, ſo that there are but very few Bodies that are more ſo: A pure alcaline Spirit, the Spirit fuming from Tin, *Glauber*'s Spirit of Nitre, and Sea-Salt, and a pure volatile alcaline Salt, indeed, have a greater degree of volatility; but this is more volatile than almoſt any thing elſe. This Liquor, when it is very much heated, readily takes fire upon the application of Flame to it, and will almoſt totally conſume. Taken internally, it cauſes Drunkenneſs and ſtupefaction of the Senſes, and then an Apoplexy. In a moderate Doſe it wonderfully raiſes the Spirits. It very ſoon heals the Nerves when they are prick'd, half torn aſunder, and in great pain. All animal and vegetable Subſtances put into it, it intirely preſerves from Putrefaction, only making ſome alteration in their Colour. If you diſſolve a little of the fineſt Sugar in this, when it is not perfectly free from Water, the pellucid Liquor you will then have, will preſerve the moſt tender Bodies. If it is diluted with Water, and then uſed warm as a Fomentation, with *Sal-Ammoniac*, and Vinegar, there is nothing perhaps that more happily reſolves *Coagulums*, diſcuſſes inſpiſſated Humours, prevents the ſpreading of a Gangrene, and cauſes a ſeparation of the unſound parts, or dries up any diſcharge of thin Humours more effectually. This Liquor is called Spirit of Wine, and that part of it that comes off firſt of all, is called the Precurſor.

30. If, when this Spirit is all drawn off, you urge the *Reſiduum* with the ſame Fire, in the ſame Veſſels, you will then have a Liquor leſs volatile, acetoſe, acid, aſtringent, cooling, nauſeous and putrid; and at the bottom there will remain ſome thick *Fæces*, which, treat them in whatever manner you will, can never be brought to ferment again, and yield new Spirits, tho' from the Conſiſtence of them, one would be very ready to expect it. If you expoſe this *Reſiduum* however, to a very ſtrong Fire, you may draw from it a fetid, empyreumatical Oil.

31. If the *Reſiduum* of any fermented Subſtance after Diſtillation, is dried and burnt in an open Fire, it is converted into ſalt Aſhes, from which may be procured a ſub-alcaline, or alcaline Salt, exactly in the ſame manner as in Proceſs 5, 6, 9, 10, 12, 19. Hence, therefore, it evidently appears, that the moſt perfect Fermentation is not able to render volatile that Matter of Vegetables, which is fixed by being burnt, and which by the 7th and 8th Proceſs, is convertible into an eſſential Salt.

32. Thus then, Gentlemen, I have given you a ſhort, but true chemical Hiſtory of Fermentation: And I have in ſuch a manner explained to you, the Objects, Helps, Impediments, Cauſes, Manner, Action, and Effects of it, that

perhaps there is not any one Phyſical Operation more clearly defin'd, and more nicely diſtinguiſh'd from all others, than this. You will be very careful therefore, for the future, not to confound this Action of Nature with any other that is different from it, if you wou'd keep free from uncertainty and error. By this means Phyſick will be purged from thoſe idle notions of Ferments, which to the great detriment of the Art have been introduc'd into it by ſome Dablers in Chemiſtry. Thus too the Natural Hiſtory of Animals and Foſſils will be freed from many inſignificant *Hypotheſes* of Ferments, which really never happen among them: In the firſt chylopoietic Organs of Animals, that live upon fermentable Meat and Drink, Fermentation ſeems indeed juſt to begin, but then to be ſoon put an end to; though perhaps in ſome few Diſeaſes it may reach farther, and be carried on through the Inteſtines. In Alchemy too the greateſt Maſters have taken an unwarrantable liberty, when from ſome reſemblance of the Operations, they have aſſerted, that Metals likewiſe ferment. In all Arts we ſhould ſtrictly diſtinguiſh every Operation by thoſe individual Properties which conſtitute the particular nature of that Action, and then as ſoon as ever the Word that ſignifies it is heard, the Mind immediately conceives what muſt certainly happen there. Let us therefore be exceeding cautious not to confound Fermentation with Effervеſcences, Ebullition by Fire, or Putrefaction of Animals, or Vegetables, concerning which we ſhall treat hereafter.

PROCESS LXIII.

Meal and Malt, work'd together with a proper quantity of Water, ferment.

APPARATUS.

1. HAVING thus laid down the general Doctrine of Fermentation, it will be proper to give ſome Examples of it, that you may perceive yourſelves the manner in which both Art and Nature proceed. And here I muſt obſerve to you, that there are two different Operations, by the firſt of which Malt Liquor, or Wine of Corn is prepar'd, and from this, Spirit of Wine; by the ſecond a Spirit is drawn at once from fermented Corn, in the ſame manner as it is from Malt Liquor. In the firſt method, upon Ground Malt you pour Water almoſt ſcalding hot, mix them will together, and let them infuſe for three or four hours, by which Infuſion alone the Malt will impregnate the Water with its flowery part, which wou'd not have been effected by crude Meal. The Liquor then being drawn off from the Malt, muſt be boil'd 'till it is reduced to a proper thickneſs; and this Decoction, in this ſtate, is emollient, looſens the Belly, purges, cools, and reſiſts Inflammation. If when this Liquor is cool you mix with it ſome ſtrong Ale Yeaſt, or Grounds, and let it ſtand in a warm place in a Veſſel with the bung hole open, there will ariſe a violent Fermentation, which being quite compleated, the Liquor is immediately ſtrain'd cold through a Cloth, and ſtopp'd up very cloſe in its Caſk, and becomes excellent Drink. But in order to keep it a good while, and prevent its growing ſour, you muſt add ſome very bitter Herbs to it whilſt it is boiling. If this Decoction of Malt then is made ſufficiently bitter, boil'd to a proper thickneſs, perfectly fermented, ſtopp'd up

very cloſe, and put into a Cellar, and after it has been kept a great while, is diſtill'd with a Worm, it will the firſt time yield as fine a Spirit of Wine as you can procure from Wine, by any Art whatever, which will be exceeding fragrant, nor have any the leaſt diſagreeable Smell. Having experienc'd this therefore my ſelf, I learn'd, that there is not ſo much difference betwixt ſuch Malt Liquor and the moſt generous Wine, and cou'd not help wondering, that this Art ſhou'd be known and practis'd in all Ages that we have any Hiſtory of. Thus *Diodorus Siculus* tells us, L. I. *That in thoſe Countries, where there were no Vines, King* Oſiris *taught the Inhabitants to make a Liquor from Barley, which in the Fragrance of its Smell, and Sweetneſs of its Taſte was not much inferior to Wine. Herodotus* too in *Euterpe* mentions an *Ale, or Wine, made from Barley.* And *Tacitus de Mor. Germ.* ſays, *they had a Liquor prepar'd from corrupted Barley, or Wheat, which reſembled Wine.* And according to *Aëtius*, βύνη ſignifies Barley wetted till it begins to germinate, and then dried.

2. But the ſame thing is done in another, and more common way as follows. I here take of ground Malt 24 pounds, of Rye Meal 7, which I order to be mix'd and work'd well together with hot Rain-water, 'till they are reduc'd to a Liquid of a middling thinneſs; I then put this into an oaken Cask, which I ſet in this wooden Cheſt, that I may keep it in a moderate Summer's Heat. By this means then it of itſelf ferments ſufficiently, ſo that I leave it till the Cruſt, which during the Fermentation is form'd at top, diſappears, and ſubſides to the bottom. I then ſtop the Cask, and let it ſtand ſome time, and the Liquor at top becomes clear, and acidiſh, and at the bottom there is collected a large quantity of a mealy Matter, that is not glutinous, but is fit for Diſtillation.

PROCESS XLIV.

Honey diluted with Water ferments.

APPARATUS.

1. I HERE, as you ſee, take ſome Honey, and dilute it with Rain-water, till it will bear up a new-laid Egg at its ſurface. This is call'd a *Mulſa.* with this I fill a Cask ſet upright, that the Hole through which the Liquor is drawn may be at top, in order to be left open; and I put the Caſk into a wooden Cheſt, and keep it conſtantly in a Heat of 70 degrees. In a little time then the Liquor begins to work with all the *Phænomena* of a true Fermentation. I leave it in this manner, 'till it has quite done fermenting, and have then a Liquor of a ſweet ſpirituous Taſte, which I ſtop up cloſe. This is call'd (*Hydromel*) Mead.

PROCESS XLV.

The Malt and Meal fermented (Proceſs 43.) diſtill'd into inflammable Spirits and Vinegar.

APPARATUS.

1. INTO this Still I throw a Pint of boiling Water, and make Fire enough to keep it boiling, and then pour in the Malt and Meal, fermented according to Proceſs 43, taking care firſt to ſhake and mix the whole well together: with this I fill the Still two thirds full. I then raiſe my Fire, and at the ſame time keep the Liquor continually ſtirring with a Stick, that the thicker part may not ſubſide to the bottom, but that the whole may continue as thoroughly mixed as poſſible. When it is grown ſo hot as to be juſt ready to boil, I fix on the Head, and manage the Fire in ſuch a manner that the Head may be very hot, and the Spirit may diſtill pretty faſt through the Worm. By this means then I have a clear, thin Liquor. This muſt be watch'd carefully, to obſerve how long it continues to come off, and muſt be kept by itſelf, under the Title of a fermented Spirit.

2. This being quite drawn off, there riſes an acidiſh, diſagreeable, nauſeous, white Liquor, in which there is nothing of the warm, ſpirituous Taſte of the former, and which, if you draw it any farther, begins to grow fetid.

USE.

THIS firſt Liquor is that which in our Hiſtory of Fermentation we deſcrib'd under the character of a Spirit produc'd by Fermentation.

PROCESS XLVI.

If Mead, prepar'd by Fermentation, according to Proceſs 44, is diſtill'd, it yields a Spirit that will burn, and a Vinegar.

APPARATUS.

1. *HYdromel*, or Mead, made in a proper manner, and kept a good while cloſe ſtopt, I commit to diſtillation; and as this is not of ſo flatulent a nature, there is leſs caution neceſſary in this Proceſs than there was in the preceding. In the firſt place then there comes off an excellent Spirit, no ways to be diſtinguiſh'd from Spirit of Wine, which muſt be narrowly watch'd, and kept by itſelf.

2. After this is intirely drawn off, change the Receiver, and then you will have an acidiſh, watery, white, diſagreeable Liquor.

USE.

Both theſe Proceſſes are Examples of the Diſtillation of Spirits from fermented Subſtances, together with the Cautions that are neceſſary to be obſerv'd in the Operation. The thick Matter, both of the fermented, mealy Bodies, and the Mead, that remains at the bottom of the Still, after the Spirits are drawn off, contains ſomewhat nutritious in it, as the *Reſiduum* likewiſe of Malt Liquor does that is treated in the ſame manner; but yet if you manage it according to the Laws of Fermentation, you can never bring it to ferment again, but it grows ſour and vapid, by no means yielding a Wine from which a Spirit may be prepared, but corrupting gradually more and more.

PROCESS XLVII.

The Depuration of the ſpirituous Liquors produc'd by Fermentation.

APPARATUS.

1. TAKE any fermented Spirits that have been once diſtill'd, fill a Still two thirds full with them, and diſtill them again with ſuch a Fire, as to make them come off in a conſtant little Stream, or juſt to make the Liquor boil. In the firſt place then you will have a very clear, thin, fragrant, ſapid, ſpirituous Liquor, during which time you muſt often remove your Receiver, to taſte whether the ſame Liquor ſtill continues to riſe. When this ceaſes, change your Receiver, and keep this Spirit by itſelf in a Veſſel very nicely ſtopt, which is call'd by the Chemiſts, rectified Spirit of Wine. And here it is certain, that thoſe Spirits which come over firſt are always the beſt.

2. If you continue your Diſtillation, you will have Liquors that are acidiſh, white, and more watery, which you muſt take great care are not mix'd with the former. Theſe come off in conſiderable quantity, and go by the name of a Phlegm, containing but very little Spirit.

3. There remains then, in the bottom of the Still, a Liquor that is ſomewhat thick, opake, pinguious, acid, of a diſagreeable Smell, and, with regard to Spirits, perfectly aqueous. When pure Brandy is diſtill'd in this manner, the *Reſiduum* is always red, and of a roughiſh Taſte, which Colour and Taſte ariſe chiefly from the wooden Caſks in which ſuch ſorts of Liquors are kept, from which they extract the oily and reſinous part; for when they are firſt diſtill'd they have neither that Colour nor Taſte, but acquire them by ſtanding in theſe Veſſels, and get rid of them again by Rectification.

USE.

1. HENCE then we ſee the method by which theſe Spirits may be ſo depurated as to be obtain'd at laſt almoſt pure and alone; for the oftener they are rectified in this manner, the more ſimple they conſtantly are, depoſiting, in every diſtillation a watery, acidiſh Phlegm: By this means, however, tho' you have them gradually purer and purer, yet they will always retain ſome Water.

2. We hence too learn, that the Spirit of Wine, ſold commonly in the Shops, under the name of Brandy, conſiſts of four parts, intirely diſtinct from one another: For it contains, firſt, the pure fermented Spirits, which we ſhall exhibit to you by themſelves in the following Proceſs; ſecondly, a pure Water, which may be ſeparated from it by the two next Proceſſes; thirdly, a certain acetoſe, fermented Acid, which riſes in the firſt Diſtillation of Spirit of Wine, and pretty tenaciouſly remains united with it, but which however may be accurately diſengag'd from it by Proceſs 49; and laſtly, a ſmall quantity of a fetidiſh Oil, which always diſcovers itſelf upon mixing Spirit of Wine, even tho' it is rectify'd, with a dry, fixed Alcali, or upon drawing it from the ſame by Diſtillation. And hence it has happen'd, that the Chemiſts, not attending to this in their uſe of common Spirit of Wine, have been ſurpriz'd with *Phænomena* which they did not expect, and which were not ſo properly owing to the pure Spirit of Wine, as to thoſe other Bodies that were mix'd with it. But theſe may be produc'd by other cauſes, whereas this Spirit is the effect of Fermentation alone.

3. There have been Authors of note among the Chemiſts, who obſerving an Acid almoſt always intermix'd with theſe Spirits, have hence aſſerted, that theſe Spirits are acid, and are generated from an Acid. But if we will examine this affair with proper attention, I am apt to think, the caſe will appear otherwiſe. For if you take the pureſt Spirits, and diſtill them from off a fixed, alcaline Salt, they will by this means be freed from every Acid that we are acquainted with, and yet they will then be genuine, and in their greateſt perfection. I allow therefore, that theſe Spirits are not produc'd, except from Vegetables, nay, and from theſe only grown acidiſh by Fermentation, but yet I muſt deny that theſe Spirits, though generated from an aceſcent Matter, are acid themſelves. We cannot therefore with juſtice aſſert, that theſe Spirits are acid or alcaline, but muſt acknowledge, that they are ſomewhat of a particular nature.

4. This Spirit, reduc'd to its greateſt purity, by this method of rectification, will ſtill always continue compounded.

PROCESS XLVIII.

Alcohol prepar'd from the fermented Spirits of Proceſs 45, 46, 47, *without the addition of any thing elſe.*

APPARATUS.

1. TAKE any fermented Spirit, particularly one that is rectified, and with a gentle Heat, not exceeding a 100 Degrees, draw it half off in a tall, narrow Cucurbit, and with the Furnace, deſcrib'd Vol. I. p. 510. The half that thus riſes firſt, treat again in the ſame manner with very clean Glaſſes, and repeat this till the *Reſiduum* that is left in the Cucurbit appears as ſtrong as that which is drawn off. This Spirit then is what goes commonly by the name of Alcohol of Wine, and is look'd upon as a pure ſimple Spirit that has nothing heterogeneous, no not ſo much as any watery Phlegm mixed with it. This was the method made uſe of by the ancient Chemiſts, only with other Furnaces. See the *Collector of Chemical Menſtruums*, concerning the methods of preparing the

Spiritus Vini Philoſophicus. The more exact ſcrutiny, however, of later Waters has diſcovered, that there ſtill lies ſome Water concealed in theſe Spirits, and that hence, Experiments made with theſe, where Alcohol without any Water mixed with it is neceſſary, prove unſucceſsful. And beſides, this tedious Operation takes up a great deal of time, for which reaſon the induſtrious Chemiſts were not at reſt till they had diſcovered ſome more expeditious method of preparing pure Alcohol, which they found might be done in the following manner.

2. They contrived a Furnace in ſuch a manner, that a pretty large Still might be ſet in Water in a *Balneum Mariæ*, and conſequently, when the Water boiled, could be affected only with a heat of 214 degrees. In this is put as much common Spirit of Wine, as will fill the Still two thirds full. An Alembic is then fitted on, which runs out into a tall, upright, narrow Tube, and is then turned down again, and has its extremity inſerted into the Mouth of a Worm. Pl. XV. You then raiſe your Fire till you make the Water in the Bath boil, and conſequently the Spirit in the Still boil more briskly, by which means, the Spirit alone being able to riſe to ſuch a height, and through ſo narrow a Tube, will diſtill by itſelf ſo long as there remains any of it in the Liquor. As ſoon as ever, therefore, the pure Spirit ceaſes to come over, the watery Phlegm not being able to aſcend, the Diſtillation will be finiſhed: And thus you will have, the firſt time, and within three or four hours, as much Alcohol as you could well procure by the preceding method in the ſpace of a month. No body, therefore, ſhould by any means be without this *Apparatus*, who has occaſion for a pretty deal of Alcohol in his chemical Operations. Upon a nice examination, however, I found, that even in this way, there was ſtill ſomewhat, tho' a very ſmall quantity indeed, of Water, intermixed with the Alcohol, which in Diſtillation, perhaps, might be carried up by the Spirits. For this reaſon, therefore, I repeated the Diſtillation with the Alcohol thus prepared, in the ſame Furnace, and I had then an Alcohol, which in almoſt every mark appeared pure, and ſimple, tho' yet, thus pure as it appear'd, it was found not to be intirely free from Water. Hence, therefore, I am induced to believe, that the Spirit can never, by this method, be abſolutely ſeparated from the Water, tho' at the ſame time I muſt acknowledge, that the quantity of Water that remains after this Operation is but exceeding ſmall.

3. On this account, therefore, I afterwards performed the Diſtillation in the following manner. I take the Alcohol that riſes the firſt time in the method deſcribed, with this I fill a Still half full, add half a pound of hot, decrepitated, pure Sea-Salt, and then putting on the Alembic, and making all very cloſe, let them continue thus for the ſpace of twelve hours, in a Heat ſo ſmall, as by no means to make the Alcohol boil. I then begin the Diſtillation, and the two firſt ounces of Alcohol that come off, I keep by themſelves, for fear there ſhould be any watery Vapour in the Tube of the Alembic, or the Worm, which by theſe firſt two ounces will be ſufficiently brought away. Of the remaining Alcohol, then, the firſt two thirds I receive into a very clean, dry, glaſs Veſſel, and keep by itſelf in a Bottle as nicely ſtopt as poſſible; and afterwards I draw off the other third, and keep that by itſelf likewiſe. The Salt then will remain in the Still wetted with the Water, which it attracted out of the Alcohol, and retained ſo tenaciouſly, that tho' it was acted upon by the Heat of boiling Water, it would not part with it, and ſuffer it to riſe with the Alcohol.

cohol. Nor does the Salt, prepared in this manner, make any alteration in the Alcohol, by mixing itſelf with it; for it is decrepitated, and put in hot. By this method, then, I have been able in a very ſhort time, to prepare the pureſt Alcohol for any chemical purpoſes.

U S E.

1. ALCOHOL brought to this degree of perfection, is the next lighteſt Fluid to Air; perfectly tranſparent; very thin; exceeding ſimple; totally inflammable, without producing any Smoke, leaving any *Fæces*, or diffuſing any diſagreeable Smell whilſt it is burning; exceeding volatile, without any *Reſiduum* left behind; abſolutely immutable in Diſtillation; greatly expanſible by Heat; very eaſily diſpoſed to Ebullition, if expoſed to the Fire; of a very pleaſant Smell; and of a particular grateful Taſte. All the Humours of the human Body, that we are acquainted with, it coagulates in an inſtant, except only the pure Water, and Urine, whilſt it hardens all the firmer parts, and thus preſerves both from putrefaction, or ſpontaneous diſſolution: Bodies of Inſects, Fiſh, Birds, and other Animals that are put into it, it ſecures from corruption, or alteration, for ages, if it is cloſely ſtopt up: With Water, Vinegar, any Acid Liquors, Oils, and pure alcaline Salts, both fix'd and volatile, it ſuffers itſelf to be mix'd, and that nearly with an equable Mixture: And laſtly, it diſſolves gummy and reſinous Subſtances. Hence, therefore, it appears, that there is no Liquor produced, either by Nature, or the Chemical Art, that is capable of being united with more Bodies than Alcohol is. But in a particular manner it proves an excellent Vehicle for the *Spiritus Rector* of Vegetables, which by a union with it, may be conveniently extracted from its proper Body, and retain'd and applied to medicinal and other uſes. Thoſe great Maſters of Chemiſtry, who were diſtinguiſhed by the Title of Adepts, are ſuppoſed, in their deſcription of the preparation of this perfect Alcohol, to have ſhadowed out the preparation of the Philoſopher's Stone: But it is certain, that Alcohol owes its origin to Fermentation alone, nor can be prepared in any other way whatever.

2. In the human Body, by its Smell, Taſte, and Vapour, it wonderfully quickens, gratefully affects, and invigorates the animal, natural, and vital Spirits, Nerves and Brain: Hence it exhilarates the Mind and Senſes, makes a Perſon briſk and agil, and proceeding through various degrees, at length cauſes drunkenneſs, which as it here comes on very ſuddenly, ſo likewiſe it goes off in the ſame manner. The Blood, its *Serum*, and other thin Juices it coagulates immediately, and hence being drank imprudently, it is ſaid to have killed Perſons in an inſtant. If it is applied externally, it dries, corroborates the Veſſels, and coagulates the Fluids in thoſe Veſſels into which it is able to penetrate. The extremities of the Nerves that it comes at, it inſtantly dries, contracts, and deprives of all Senſe and Motion. Hence it appears, how imprudently, nay, and often how unhappily Alcohol, either pure or impregnated with aromatic Spirits, Camphire, or the like, is made uſe of as a Fomentation in chirurgical caſes, and ordered to be heated and well rubb'd in. I would adviſe you therefore to be cautious upon this head, for inſtead of a pretended vivification, calefaction, reſtoration of agility, reſolution, and diſſipation, you will

obtain no other effects than what I juſt now aſcrib'd to theſe Spirits. In Wounds too, Ulcers, and other open Maladies, pure Alcohol performs the very ſame thing, *viz.* coagulates, and dries and burns the Nerves. Its true indeed, it eaſes the Nerves of all ſenſe of pain; but then at the ſame time it deſtroys all their uſe. And it has the ſame effect when it aſſwages thoſe that are prick'd, or half torn aſunder. It at once ſtops bleeding by contracting the Veſſels, and coagulating the Blood it is apply'd to, but with the concomitant circumſtances juſt mentioned. Hence, therefore, it is often a very ſpeedy and excellent remedy in theſe caſes, tho' always attended with ſome inconveniences.

3. From what has been ſaid then, we learn what effect pure Alcohol has upon animal or vegetable Subſtances that are put into it: For if there is any thing oily in theſe that the Alcohol can get at, it diſſolves it, and extracts it out of them, and hence theſe afterwards become contracted and wrinkled. In this manner, the preparations of the parts of Animals have often been obſerv'd to be chang'd: And aromatic Flowers, Leaves, and Fruits, are affected in the ſame manner. If little Birds, or other ſmall Animals covered with hard Scales, are immerſed in hot Alcohol, they are beautifully preſerved, as this contraction, tho' it does actually happen, yet on account of their Feathers and Scales does not in theſe appear ſo evident. And if after theſe have been macerated for ſome time in the pureſt Alcohol, till they are thoroughly penetrated by it, they are then taken out, dried in an Oven not too hot, put into glaſs Veſſels, and intirely kept from any communication with the external Air, they may be kept in their proper form for ages, to the very great advantage both of Natural and Pharmacal Hiſtory, as by this means they may be tranſmitted ſafe to poſterity, whereas deſcriptions are frequently defective.

4. As there are a great number of inſtances, and thoſe of conſequence too, where both the Chemiſts and other Artificers have occaſion for the moſt pure and perfect Alcohol, the leaſt admixture of any heterogeneous Matter immediately rendering the Operation unſucceſsful; hence it is abſolutely neceſſary we ſhould have ſome marks by which we may be able to diſtinguiſh, whether our Alcohol is pure or no: The chief of theſe then, I ſhall now lay before you, and they are as follow: 1. If the Alcohol contains any Oil diſſolv'd in it, and ſo equably diſtributed through it, that it is no ways perceptible, then upon the pouring of Water into it, the Mixture will grow white, and the Oil will ſeparate from the pure Alcohol. 2. If any thing of an Acid lies concealed in Alcohol, a little of it mixed with the alcaline Spirit of *Sal-Ammoniac*, will cauſe an Efferveſcence, and thus diſcover the preſence of the Acid; for otherwiſe there would be only a ſimple *Coagulum.* 3. If there is an alcaline Salt in it, this will appear too by the Effervelcence excited on pouring in an Acid: And as for other Salts, they are ſeldom found in it. 4. But it is a matter of greater difficulty to find out whether there is any Water intermix'd with it; and therefore the Chemiſts have contrived certain methods, by which this may be examined likewiſe. In the firſt place then, they imagined, that after having gone through the tedious labour of the repeated Diſtillation above-mentioned, they might be ſatisfy'd that they were in poſſeſſion of pure ſimple Spirits, without the admixture of any watery Phlegm; but as I took notice to you before, I have never been able in this manner to procure pure Alcohol, but it would to the laſt retain ſomething of Water. Secondly, they put ſome Alcohol into

a clean, dry Spoon, and heating it, ſet it on fire in a place where there was not the leaſt Wind, and if after the Alcohol was burnt out, there was no Water at all remaining in the Spoon, they at once pronounced it pure Alcohol. Some Perſons however who were more curious by other Experiments, which we ſhall mention by and by, diſcovered, that by the action of the Flame, the Water that lay concealed in the Alcohol might be diſperſed into the Air, and conſequently, that no Water remaining in the Spoon after the conſumption of the Alcohol, was no certain proof, that there was none contained in it before it was ſet on fire. In the third place, therefore, they took ſome of the beſt Gun-powder, and drying it very well, put a little of it into a dry Spoon, and pour'd ſome Alcohol upon it, and then heating the Alcohol, ſet it on fire, by applying a Flame to its Surface. They then let it burn away in a quiet place, and if the Gun-powder fired when the Flame was juſt going out, they concluded certainly that the Alcohol was pure: But againſt this Experiment there lies the very ſame Objection as againſt the former. Theſe two laſt Methods, therefore, when they ſucceed, demonſtrate, that the Alcohol, with reſpect to Water, is very pure, but not that it is abſolutely ſo. In the fourth and laſt place, therefore, there has been another way diſcovered, by which it may be certainly known whether Alcohol contains any Water at all in it, and that is this. Take a chemical Vial, with a long narrow Neck, the Bulb of which will hold four, or ſix ounces of Alcohol. Fill this two thirds full with the Alcohol you want to examine, into which throw a drachm of pure, dry Salt of Tartar, coming very hot out of the Fire, and then ſhake them well together, and ſet them upon the Fire till the Alcohol is almoſt ready to boil. If then, after they are thus ſhaken and heated, the Salt of Tartar remains perfectly dry, without the leaſt ſign of moiſture, we are ſure that there is no Water at all in this Alcohol. If any Perſon will ſtill contend that there is Water in it, upon the foot of that Experiment, that Water may be collected from its Flame whilſt it is burning, of this I treated ſufficiently, Vol. I. p. 188, 189, which therefore, if you pleaſe, you may have recourſe to. By this method, now, I have been able to diſcover Water in Alcohol, that by the others appeared perfectly free from it: For I took ſome Alcohol, which burnt intirely away, and ſet fire to Gun-powder, and upon putting ſuch an alcaline Salt into it, I perceived by the Moiſture it acquir'd, that there was ſtill ſome Water in it: And again, I took ſome Alcohol in which there was a fixed Alcali that had remained dry for a long time, and was ſo when I made the Experiment, and gently mixed a few drops of Water with it, and tho' the Salt had continued dry ſo long, it ſoon after grew moiſt from this ſmall quantity of Water, and appeared in oily ſtreaks running down the Sides of the Glaſs. Thus, therefore, the true nature of Alcohol is ſufficiently determined by its individual Properties; eſpecially if to what has been, you add this Obſervation, that ſuch an Alcohol does not appear whilſt it diſtills through the Alembic: For it neither forms dewy drops like Water, nor runs down in *Striæ* like ſtrong Spirit of Wine, but is quite inviſible; which property of it, as evidently appears by their Writings, was known to the ancient Chemiſts. This then is the ultimate effect of Fermentation, as it is ſcarce poſſible to carry this Alcohol to any greater perfection, or indeed, to induce upon it any alteration.]

PROCESS XLIX.

A Preparation of Alcohol with Alcali's.

APPARATUS.

1. AS one often wants a large quantity of pure Alcohol out of hand, and perhaps ha'n't by one a chemical *Apparatus* ready for preparing it, the following method which I am going to propoſe to you, will anſwer the purpoſe very well, provided it would be no ways inconſiſtent with the uſe you want it for, that there ſhould be a ſmall matter of a fixed Alcali mixed with it. In this clean glaſs Cucurbit, then, I have ſome common Spirit of Wine, into which I pour a third part of its weight, of pure dry Pot-aſhes, which preſently fall to the bottom. I ſhake the Veſſel then, and you perceive the Salt immediately grows moiſt, and begins to diſſolve at the bottom, whilſt a thin red Liquor ſwims at top. And the more I ſhake them, the more the lower part melts, and the upper ſeparates from it; nor is it ever poſſible to make them mix thoroughly together, but as ſoon as ever they come to ſtand ſtill, they immediately collect themſelves into two perfectly diſtinct *Strata.* And here the ſtronger the Spirit of Wine is, the greater will be the quantity of the upper Liquor; and the contrary.

2. Let the Veſſel ſtand quiet for ſome time, that the Liquors may become intirely ſeparated, and then by a gentle inclination of the Glaſs, pour off the upper Liquor into another dry Cucurbit, taking as much care as you can, that none of the lower goes in along with it. At the ſame time let there be ready in the Fire a very dry, fix'd, alcaline Salt, which muſt be put hot into the Spirit thus deprived of ſome of its Water, and then the Glaſs muſt be ſtopt, and ſhook about for a conſiderable time; upon which you perceive the dry Salt acquires ſome farther Moiſture. I proceed then to ſhake them together, till I obſerve that no more of the Salt will be diſſolved, but that there ſwims at top a red limpid Liquor which will be ſo much the purer, as the alcaline Salt was drier and hotter, and was longer ſhook about with the Liquor. This being done, I pour off the Liquor into a tall dry Bolthead, and throw into it a little more alcaline Salt that is exceeding dry, pure, and hot, and ſet them in 100 degrees of Heat, ſhaking them about very frequently; and if the Salt don't then grow at all moiſt, the Alcohol will be perfectly freed from its Water, but then it will have a red Colour, a Taſte not ſimple, and a ſomewhat diſagreeable Smell, and by its Effervescence with Acids, and its lixivious Taſte, will evidently diſcover the preſence of a latent Alcali. And here we take notice, that in this Operation, there always appears a pinguious Oil, which ſeparates itſelf from the Spirit of Wine, or the Pot-Aſhes, or perhaps from both, and has a fetid Smell. The fixed Alcali too, here made uſe of, by abſorbing and uniting with itſelf the Acid which was in the Spirit of Wine, is altered in its nature, and at laſt becomes a compound Salt and a pretty volatile one too. And hence I found, that when this Salt had been made uſe of a good many times, and ſo was dried after every Operation, it at laſt was almoſt of the nature of the *Terra Foliata Tartari*, and intirely unfit for any purpoſe, where there was re-

quired a fixed Alcali. Hence then again is confirmed what was advanced concerning the nature, and different component parts of common Spirit of Wine.

3. If Alcohol, thus prepared, is diſtill'd once in a Cucurbit, with a gentle Fire, it becomes ſufficiently ſimple, and fit for almoſt all the uſes where you want a pure Alcohol. It's true indeed, there will be ſomewhat ſubalcaleſcent ſtill united with it, though this too may be prevented by cautiouſly adding a few drops of Oil of Vitriol before the Diſtillation, and proceeding ſo long as there is any effervefcence excited, and no longer; for if you then diſtill it, your Alcohol will be pure.

4. Hence then we ſee, that the preparation of abſolutely pure Alcohol is not ſo eaſy as ſome Perſons pretend: For in Diſtillation there is an acidiſh, and a watery Liquid intimately combined with it, and if you add an Alcali to it, though it frees it from the former, will ſtill continue cloſely united with it itſelf. For this reaſon then we need not be at all ſurpriz'd, that ſome very curious Experiments, that require the pureſt Alcohol, do ſo ſeldom ſucceed. And hence it is plain, that an alcaline Salt will often properly diſpoſe Alcohol for particular Operations, either as it frees it from its Water, Acid, and Oil, or as it impregnates it with an alcaline quality, and thus improves its diſſolving power. We muſt have a proper regard therefore to all theſe conſiderations, before we can pretend to pronounce, concerning its ill, or good effect.

5. The Chemiſt, therefore, when he has once produc'd ſuch Alcohol as we have deſcrib'd, finds he is come to the Limits of his Art, as it cannot be carried to any greater perfection, be reſolved into any more ſimple principles, or indeed be any ways altered. Upon a carefull examination, now, into this affair, I here experienc'd, that the moſt limpid Spirit of Wine, depurated by one common diſtillation, or, as it is called, rectified Spirit of Wine, might, by the affuſion of the pureſt dry Salt of Tartar, be divided into two parts, and thoſe ſometimes nearly equal, one of which was ſimple Water, the other the pureſt Alcohol; and this is a Truth ſufficiently known: But, after a great number of Experiments, I cou'd never yet ſee, that ſimple Alcohol, by being mixed with a pure fixed Alcali, wou'd unite its oily half with the alcaline Matter into the form of a balſamic Soap, called the *Samech* of *Paracelſus*, the other half at the ſame time ſeparating itſelf into mere elementary Water. This, indeed, the great *Helmont* aſſerts, p. 58. 86: But this ſeparation, as far as I am able to judge, ſucceeds only with rectified Spirit of Wine, and then indeed not as the followers of *Helmont* maintain, *viz.* that the Sulphur of the Wine aſſociates with the alcaline Salt; for in my Experiments the Water is attracted into the Salt ſo long as there is any in Alcohol, and the Alcohol is repell'd, whereas they ſay, that the Oil of the Alcohol unites with the Salt, and expells the Water.. But in the eightieth Proceſs I ſhall have occaſion to lay before you ſome very laborious Operations upon this head, nor is any thing more neceſſary to our preſent purpoſe.

PROCESS L.

The Origin of Vinegar.

APPARATUS.

1. HAVING rightly underſtood the Effect of one Fermentation, *viz.* the generation of Alcohol, we muſt now take into conſideration another production of it, and that is vinegar, which cannot any ways be procur'd but by Fermentation, and that a double one too; for you muſt firſt make Wine, before you can make Vinegar, and then indeed any Wine is fit for this purpoſe. For if you take any ſort of Wine, and mix with it a large quantity of its own Lees, and the Flowers that riſe to the top during its Fermentation, adding too a good deal of powder'd Tartar, together with the Skins, Stalks, and Twigs of the Vine, and the acid, auſtere Leaves, that have a ſaline, tartareous Matter in 'em; then, if you ſtir theſe well together, and ſet them in a warm place, particularly in wooden Casks that are thoroughly penetrated with the Vapour of Vinegar, and in an Air that is full of acetoſe Vapours likewiſe, they will by this means undergo a new Fermentation, with a conſiderable production of Heat. And in this particular, this ſecond acetoſe Fermentation differs from the former; for if this is protracted too long, the Wine, indeed, grows ſouriſh, but then it grows flat, and never becomes good Vinegar. In order to this, therefore, a particular Management is required, which we ſhall preſently lay before you.

2. The remote Matter, therefore, of an acetoſe Fermentation are all Vegetables, that are diſpos'd to a vinous Fermentation, provided they are firſt, by this, converted into Wine. The Matter from which Vinegar is immediately prepar'd, is every ſort of Wine, with this Circumſtance, however, that the ſtronger the Wines are, the ſharper generally are the Vinegars that are made from them, whilſt the ſmaller Wines produce a weaker.

3. The Ferments now by which this acetoſe Fermentation is moſt ſucceſsfully aſſiſted, are particularly theſe.

1. The acid *Fæces*, or Lees of an acidiſh Wine.
2. Grounds of Vinegar collected in old casks, eſpecially if they are well ſaturated with very ſtrong Vinegar.
3. Tartar from an acid Wine, reduc'd to Powder.
4. Vinegar itſelf, properly prepar'd, and brought to its greateſt degree of ſharpneſs.
5. Old wooden Casks, which have laid for a good while full of the ſtrongeſt Vinegar, and hence are thoroughly penetrated with its ſharp Acid.
6. The frequent ſtirring up of the Lees in its own Wine.
7. The Stalks and Skins of Cherries, Currants, and Grapes, the Tendrels of Wines, and ſuch parts of other acid-auſtere Vegetables.
8. The acid Rye-Leaven of the Bakers.
9. A Compoſition of all the preceding mix'd together, eſpecially if there are ſome very warm Aromatics added to the Acids; for then the Vinegars made with them are ſtrongeſt.

4. This whole Operation was formerly accurately deſcrib'd by *Glauber* in his Writings againſt *Barner*, an account of which was afterwards publiſh'd by the *Engliſh* in their *Philoſophical Tranſactions*, and is in ſhort as follows. There are two large oaken Veſſels made in the ſhape of common Casks, in each of which, at the diſtance of a foot from the bottom, as they ſtand upright, there is fix'd a wicker Grate. Upon theſe Grates are laid a *Stratum*, of a moderate thickneſs, of freſh, green Twigs of Vines, and over theſe, to chuſe, ſuch a quantity of the Stalks of Grape-bunches without any Grapes on 'em, as is ſufficient to fill the Veſſel to within a foot of the top. Theſe two Veſſels then being thus prepar'd, the Wine of which the Vinegar is to be made is pour'd into both of 'em, but with this difference, that one of 'em is fill'd quite full, the other only half full; and then every day that which is half full is fill'd out of the full one, ſo that each of them are half full one day, and quite full the next. By this means then, the ſecond or third day there ariſes a fermentative Motion, with a ſenſible heat, in the Veſſel that is half full, which every day increaſes more and more in the half full one, whilſt in that which is quite full the ſame day the Motion and Heat is almoſt ſuffocated, and put a ſtop to; ſo that hence the Fermentation and Heat are excited and deſtroy'd alternately in each of the Veſſels. In this manner they continue to fill them one out of t'other, till there appears no more Heat or Motion, even in the half full one, which is then a ſign, that this acetoſe Fermentation is finiſh'd; for which reaſon the Vinegar muſt be then put up in Casks, and ſtopp'd cloſe. The hotter now the place is where theſe Veſſels ſtand in which the Vinegar is prepar'd, the ſooner will it be made, which in *France* is compleated in Summer in about fifteen days: But in cold weather, and a cold place, the Operation is longer. And here it is neceſſary to obſerve, that when either the Weather, or the Work-houſe, is very hot, it is often neceſſary to fill and empty the Veſſels, in the manner deſcrib'd, every twelve hours; for otherwiſe there ariſes ſuch a Heat and Fermentation in the half full one, that the volatile Spirits of the Wine, not being yet ſufficiently ſecured, are diſſipated by the Heat, and fly off before they can be properly intangled and fixed into the acid Spirit of the Vinegar: And hence the Liquor, though it wou'd be ſour indeed, would at the ſame time be flat, and by no means ſharp ſtrong Vinegar. For this reaſon too, the Veſſel that is half full is always accurately cloſed with a Cover made of the ſame Wood with the Veſſels, that the Spume of the fermenting Liquor may be forced down again, and thus the repell'd Spirits may act longer and more powerfully upon the auſtere Subſtances underneath, and by the reaction of them be better ſecur'd from diſſipation. But the full Veſſel is not cover'd, but left quite open, that the Air may have a free admiſſion to the Liquor to be changed. This then, Gentlemen, is that ſecond Fermentation, that tends to the making of Vinegar, and terminates there. It is wrong, therefore, to look upon this as a Liquor prepar'd after the inflammable Spirits of the firſt Fermentation are gone off; for this wou'd be flat and dead, and far from Vinegar. On the contrary, the more generous, and the fuller of Spirits the Wine is that is uſed for this purpoſe, the better will be the Vinegar; the ſmaller, or flatter it is, the weaker. For this reaſon, the ſtrongeſt Malt Liquor, if it is treated in the ſame manner, yields an exceeding good Vinegar, as the rich *Spaniſh* Wines do likewiſe. In this Operation, now, it is particularly remarkable, that this conver-

verſion of Wine into Vinegar is not brought about without a conſiderable Heat's being generated during the Fermentation; whereas Muſt, whilſt it ferments in the time of Vintage, ſcarcely grows warm; and Malt-Liquor, notwithſtanding the violent Motion that is excited during its working, not at all. Is Heat, therefore, always neceſſary to the generation of an Acid? Certainly frumentatious, and other vegetable Subſtances, and Milk, in order to their growing ſour, require warm Weather, artificial Heat, or that of the human Body. And we ſee, that the extreme force of the Fire converts Salt that is not aceſcent, and Nitre, and Sulphur, which are not acid, into the ſtrongeſt Acids. Think carefully of theſe things, Gentlemen, and you'll find, perhaps, that every thing muſt have its proper degree of Heat. But there is ſomething elſe here that deſerves our conſideration, likewiſe, and that is, that whilſt Wine, by the method deſcrib'd, is converted into Vinegar, this clear thin Liquor depoſites an incredible quantity of thick, pinguious, oily, and as it were ſoapy *Fæces*, which hang about the ſides of the Veſſels, the Vine Twigs, and the Stalks of the Bunches. Whence, now, ſhou'd this ariſe? In the Wine, certainly, there is not the leaſt ſign of any ſuch thing, and as for the rough Twigs and Stalks, there is nothing one wou'd expect leſs there, than a pinguious Oil. And yet it is in this manner form'd from the Wine; for if it is waſh'd off it will be generated from it again. And here we muſt obſerve, that it is neceſſary once a year to clear away all this thick unctuous Matter, for otherwiſe, when the Wine was put into the Veſſels, it wou'd not be chang'd to a thin ſharp Vinegar, but a thick, corrupted, pinguious Liquor good for nothing at all. The Twigs, therefore, which are now very turgid with a Ferment of the ſharpeſt Vinegar, are waſh'd from the greaſy Matter with which they are loaded, and this is done as expeditiouſly as poſſible, that the Water mayn't fetch out any of the Acid with which they are impregnated. The Grates, Sides, and Bottom too, of the Veſſels, in which the Vinegar is made, are clean'd with the ſame caution, and as ſoon as ever the pinguious Impurities are remov'd, the Grates, Twigs and Stalks are diſpos'd as before, and are fit to proceed to work with again. In time, however, the ſame oily Cruſt will be form'd again, and thus evidently demonſtrate, that the Wine does actually throw out an Oil whilſt it is chang'd from its own proper nature, to that of Vinegar. At the ſame time too, the acetific Ferment remains in the Veſſels, Grates, and Stalks; and hence, when theſe Veſſels have been us'd a great while, they acquire this Power very ſtrongly, and with the Grates, *&c.* become ſpongy *Reſervoirs*, as it were, of Vinegar. And laſtly, as the Alcohol, which I mention'd before, prepar'd from very ſtrong old Malt Liquor, can ſcarcely be diſtinguiſh'd from that drawn from the richeſt Wine; ſo here the ſame Malt Liquor, treated in the manner explain'd, may be converted into Vinegar, as good, pure, and fit for any uſes, as ever was made from the beſt Wine; nor is it eaſy here to find any difference betwixt them, except what is owing to the Bitters put into the Malt Liquor, to make it keep, which give it another Colour and Taſte from what it wou'd have had if it had been prepar'd from the pure Corn: In other reſpects they are intirely alike. This Operation therefore appears ſufficiently evident.

5. The effect therefore of this ſecond Fermentation, when it is abſolutely finiſh'd, is the production of good Vinegar. In order now to have a right notion of this affair, let us conſider what this Vinegar is. Vinegar then is

an acid, penetrating, ſubpinguious, volatile, vegetable Liquor, produc'd from Wine in the manner juſt deſcrib'd, the firſt part of which that riſes in diſtillation is truly acid, and by no means inflammable, but extinguiſhes Fire and Flame, in the ſame manner that Water does. Theſe Properties therefore, which, if rightly attended to, appear pretty extraordinary, accurately diſtinguiſh Vinegar from Wine. Wine then, by one Fermentation, is prepar'd directly from Vegetables; Vinegar, by a ſecond Fermentation, from Wine that is already made. The volatile part that firſt riſes from Wine in Diſtillation, will take fire, and riſe into a bright Flame; that from Vinegar, like Water, puts it out. Here, therefore, there is a very extraordinary production of one thing from another of a different nature. Some of the moſt skilful among the Chemiſts, indeed, have aſſerted that Vinegar is a volatile Tartar of Wine; becauſe Tartar is the moſt acid part of Wine, but not volatile; Vinegar, Wine converted into an Acid, but a volatile one. And this too they thought ſtill farther confirmed by this conſideration, that Wine for the moſt part depoſites a Tartar; Vinegar, though it ſtands by a great while, never any, though as it is deprived of a great part of its Oil in making, and hence is rendered ſo much the more acid, one wou'd naturally expect it ſhou'd generate a greater quantity. And it is true, indeed, that what remains at the bottom after the Diſtillation of Vinegar, ſeems to come near to the nature of Tartar, but yet, upon a nicer Examination, we find it ſomething very different from it, as we ſhall ſee in the following Proceſs. It will be of ſervice to us, now, not only with regard to the Chemical Art, but, with a view to Medicine and Natural Philoſophy, to have a clear notion of the nature of this Vinegar, which we ſhall endeavour therefore to lay before you in the following particulars.

1. Vinegar, then, is a Liquor, diſtinguiſh'd by its proper Marks abovementioned, to which we only now add, that it is a volatile, oily, acid Salt; for its Oil, which lies ſurprizingly conceal'd under a ſharp, thin Acid, moſt evidently diſcovers itſelf by a great many Experiments, which we ſhall hereafter give you in the 76th and 173d Proceſſes. This Compound, now, is vaſtly beneficial to the human Body; for at the ſame time that by its Acidity it reſiſts Putrefaction, which the animal Humours are ſo incident to, and which is of ſo dangerous a conſequence, it is ſoften'd by its Oil, and render'd leſs acrid. This Liquor, too, is of ſo penetrating a nature, that it ſoon inſinuates itſelf through very denſe Subſtances, in its full ſtrength, and without any ſeparation of its parts, nay, will make its way through almoſt all the human Body, and thus being diſtributed into the chief of its Veſſels, well exert its proper Powers there, eſpecially as it is then aſſiſted by the natural Heat, and vital Motion. And then again it very readily ſuffers itſelf to be mix'd with any of the animal Fluids that we are acquainted with, the Oil itſelf not excepted, by which means, and its penetrating power together, it is capable of producing many beautiful effects in our Bodies. In Fevers, ariſing from a ſtimulating acrid Bile, an alcaleſcent Salt, any thing putrid generated in the Body, or the venomous bite of an Animal, it has an excellent cooling Power, and at the ſame time aſſwages the Drought that accompanies 'em. And hence, in theſe caſes, we have nothing extoll'd more by *Dioſcorides* and *Hippocrates*, than Oxycrate, or Vinegar and Water, eſpecially when render'd milder

by an addition of Honey. In external Maladies, as Eriſypelas's, Phlegmons, and putrid Ulcers, the Surgeons find nothing of greater ſervice. In virulent Bites, there is not any thing more efficacious than Oxycrate, as appeared evidently in the Bite of a mad Dog. And as to making Perſons fuddled, it is in its nature ſo diſtant from that, that whereas fermented Spirit of Wine is the only thing that promotes it, Spirit of Vinegar proves a remedy for Drunkenneſs where it is excited, nay, tho' a Man is quite drowned in Sleep from the abuſe of ſpiritous Liquors, he may be rouſed by giving him Vinegar. Hence, in ſtimulating the Nerves, and quickening the Spirits, there's ſcarcely any thing of greater ſervice. In weak, languid, drowſy, and lethargic Perſons, and thoſe afflicted with Syncopes and Vomitings, after having tried the moſt artful chemical productions in vain, I have given relief by applying Vinegar to the Noſe and Mouth, or adminiſtring it inwardly. Nay farther, which hardly any body wou'd be ready to believe, but thoſe that have experienced it, in Convulſive, Hypochondriacal, and Hyſterical Caſes I have often known it do good likewiſe. Juſtly, therefore, did *Hippocrates* and *Galen* recommend its uſe to Hypochondriacs. In a true Putrefaction too, and deadly Corruption of the Humours, and in preventing the ſpreading of a Gangrene, I ſpeak experimentally, it has ſcarce its equal. But what need is there of many Arguments to this purpoſe? In the extreme Heat of Autumn, when every thing runs preſently into a putrid *Sanies*, are not Fleſh and Blood kept from Corruption by ſprinkling them plentifully with Vinegar? But, with proper reſpect to thoſe Gentlemen who are of another opinion, I aſſert farther, that Vinegar has an attenuating Power likewiſe: For if it is mix'd warm with the Blood, or its *Serum*, it does not coagulate them, nor by its admixture generate any Polypus's, but on the contrary, dilutes them, and kindly reſolves them when they are coagulated. In acute Fevers, therefore, in malignant burning Fevers, in the Plague, the Small-pox, Meaſles, and the like Diſtempers, Vinegar is an excellent Medicine, where volatile alcaline Salts are uſed with ſuch unhappy ſucceſs; for by their ſtimulating Acrimony they increaſe the Velocity, and of conſequence the Denſity of the Blood, which depends upon it. Conſiſtent with this, certainly, was the practice of the famous *Franciſcus de le Boe Sylvius*, who, if not the Author, was at leaſt a vaſt admirer of the *Sal Volatile Oleoſum*; for by the help of what Prophylactic did he viſit his Patients in the Plague, without any inconvenience? Why by only drinking an ounce or two of Vinegar: Nay, he tells us, that happening once to omit it, he preſenly ſuffered for his negligence by a Pain in his Head. And laſtly, to conclude, a more certain and efficacious Sudorific we are not acquainted with; for Vinegar, either diluted, or alone, will procure a plentiful Sweat, in the Plague, and other malignant Diſeaſes, where other things ſeldom prove ſucceſsful.

2. The Generation, now, of this Vinegar ſeems to depend upon the Combination of the inflammable Spirit, produced by the firſt Fermentation, with an Acid ſomewhat more fixed, which lay concealed in the Wine; for that theſe inflammable Spirits are not loſt, or periſh, we have made appear already. May therefore theſe Spirits, by the ſecond Fermentation

be united with the eſſential Salt of the Wine, or the Tartar? This I leave to your mature examination, only adding, that it does ſeem here as if the Spirit of Wine was altered in its nature, and ſo put on that of Vinegar. And if this is the caſe, this, may be, is the only way commonly known, in which the Matter of Alcohol is actually changed into ſomething elſe.

3. Perhaps the moſt beautifully eſſential Salt of Wine is the Tartar that is generated from it; but this is all conſumed in the making of Vinegar, tho' there is nothing at the ſame time ſeparated from it, but a thick oily Matter: For if you take the fineſt new Rheniſh Wine, and put it into a clean Pipe, it will produce a great quantity of excellent Tartar; but if after it is made into Vinegar, by the Method deſcribed, it ſtands ever ſo long, it will generate none; and yet, as I took notice before, there is nothing depoſited or formed, during the ſecond Fermentation, that at all reſembles Tartar, but only a pinguious tenacious Matter, that is as different from it as poſſible.
4. In the Diſtillation of Wine, the Spirit produced by one Fermentation, comes off before the Water; but in old Vinegar prepared by two, the watery part riſes firſt, and when this is drawn off, there follows an acid Spirit, which is always the ſtronger and more acid, the lower you draw it. Hence then we ſee, that the firſt Fermentation renders its proper production volatile; the ſecond rather makes what that generates, more fixed. If we attend carefully, therefore, to the Action of Fermentation, it certainly appears very ſurpriſing: For from ſweet Muſt it produces an acidiſh Wine; from a Matter in which there was no Alcohol before, it generates Alcohol; and again, from a ſweet Wine forms an Acid; and from the Matter of Alcohol, gives us ſomewhat as different from Alcohol, as poſſible.
5. The helps to this ſecond acetoſe Fermentation, are
   1. A conſiderable degree of Heat.
   2. The free acceſs and admixture of the Air.
   3. The ſtirring the Liquors about, and mixing them together in the open Air.
   4. The addition of ſome very warm Aromatic during the Fermentation.
6. The Impediments to this Fermentation, are every thing that I mentioned to you before, in our account of the firſt Fermentation, under this Title, except that ſtirring the Liquor about is here of ſervice, whereas in the other it does harm.

Thus then, Gentlemen, I have laid before you the whole Hiſtory of Fermentation, both vinous, and acetoſe.

PROCESS LI.

The Diſtillation of Vinegar, into an acid Water, an acid Spirit, an Extract, a Sapa, *Tartar, and Oil.*

APPARATUS.

1. TAKE ſome old Vinegar, made from the beſt Wine, fill a tall glaſs Cucurbit three quarters full with it, and with a gentle Fire draw off one quarter.

This then will be light, and limpid, will be diſperſed all over the Alembic in form of dewy Drops, and will run down like Water, not in *Striæ* like Spirits; the Taſte of it too will be acidiſh; and if it is thrown upon Flame, it will extinguiſh it in the ſame manner as Water does. If this Water is diſtill'd again to one half in a clean Cucurbit, the part that comes off firſt conſiſts chiefly of Water, and is of excellent ſervice, where one wants a very mild Acid. In this the Writings of all the Chemiſts have agreed. *Vigani*, however, has taken the liberty to aſſert, that the Liquor that firſt riſes in the Diſtillation of Vinegar, is inflammable, and will burn if it is thrown upon Fire. To put an end therefore to this diſpute, I'll relate to you, what, upon examination, I have found to be the caſe. I took twenty Pints of Vinegar, which was made in *France*, and thence brought here immediately, and had not yet acquired a very ſour Taſte, and putting it as it was into a very large glaſs Retort, with a great deal of patience, I diſtill'd it with a gentle Heat, upon which there roſe a Vapour into the Receiver, which when it came to be cool, form'd oily ſtreaks upon it, juſt ſuch as one ſees in the Diſtillation of Wine. I was ſurpriz'd, I confeſs, at this, and therefore proceeded in the ſame gentle manner, till theſe *Striæ* were ſucceeded by ſome dewy Vapours diſperſed about in the ſame manner as happens in the Diſtillation of Water and Vinegar. I preſently then remov'd what came off firſt, which had a Taſte like common Spirit of Wine diluted with a weak Vinegar, and if it was thrown upon a bright Flame, burnt like Spirit of Wine. When the ſame Vinegar, however, was better than a year old, and had been kept all the time in a Veſſel nicely ſtopt, upon performing the ſame Operation the ſucceſs was different, for then what came off firſt was not an inflammable Spirit, but a mere watery Vapour of Vinegar. Hence, therefore, I learnt, that the inflammable Spirits are by time intimately fix'd into the Acid of the Vinegar; that hence the Taſte of new Vinegar ſtill continues vinous, but gradually grows ſharper, and ſourer; that then all the firſt inflammable Spirits are chang'd, and none but Acid ones remain; that ſomewhat therefore truly inflammable, is by this means converted into Vinegar, which is not inflammable afterwards; and that for theſe reaſons, what the Chemiſts have aſſerted is true, tho' *Vigani*'s Opinion muſt be allow'd ſo likewiſe, if you underſtand it of new Vinegar.

2. I then increaſed my Fire a little, in order to diſtill the remainder of the old Vinegar, which was three quarters of the whole, and kept it up in this degree, till I had drawn off two thirds of this *Reſiduum*, ſo that now there was only one pint left in the Retort, of four I made uſe of at firſt. This Liquor then appeared in drops like Dew, was of a much acider Taſte than the former, nor of a diſagreeable Smell, but ſomewhat ſub-empyreumatical. It was heavier too than the former, for being mixed with it, it ſubſided to the bottom. This may properly be called diſtill'd Vinegar.

3. If the remaining quarter is diſtill'd with a ſtill ſtronger Fire out of a glaſs Retort into a Receiver not too cold, there will come over a very limpid Liquor, exceeding acid, and ſo penetrating, that it will inſinuate itſelf through the Lute. This will ſcarcely riſe, except it is urged with a great degree of Fire, and then will heat the Receiver ſo much, as to make it eaſily fly. Even here, however, there is no appearance of Streaks, and if this Liquor is thrown upon Fire, it puts it out. Proceed then till there remains only a twentieth part,

or leſs of the Vinegar firſt made uſe of. This laſt Liquor will have an empyreumatical Smell.

4. This being done, there will be left at the bottom of the Retort, a black, thick, acid, oily Liquor, ſmelling very ſtrong of an *Empyreuma*, which being urged with the laſt degree of Fire, will yield an exceeding acid, heavy, empyreumatical, fetid Liquor, and an Oil of a ſurpriſingly fetid Smell, whilſt there remains a black, acid *caput mortuum* in the Retort. This being burnt in an open Fire, yields a bright Flame, and produces ſome brown *Fæces*, in which there is a large quantity of an acrid alcaleſcent Salt.

5. Hence then it appears, that there does not remain the leaſt appearance of Alcohol in ſo large a quantity of Vinegar; that there is nothing here of the nature of Tartar, but that the whole rather, a very ſmall part only excepted, is become volatile; and that Vinegar is abſolutely of a different nature from any other Acids that we are at preſent acquainted with.

Theſe things, Gentlemen, I have gone through, before you in this manner, that you might get an inſight into the nature of Vinegar from its Compoſition and Reſolution. This Operation, however, would be both too tedious, and chargeable for preparing diſtill'd Vinegar for common chemical uſes. For this purpoſe, therefore, we take a copper Still, well tinn'd within, and fill it three parts full of Vinegar, and then fixing on a glaſs Head, proper for this uſe, we diſtill with a Worm, raiſing ſuch a Fire as to make the Vinegar boil. The firſt quarter part then that comes off we collect by itſelf, and afterwards draw off two quarters more, which we keep under the Title of diſtilled Vinegar for Chemical Operations. The other quarter that remains in the Still may be ſaved too, till by repeated Diſtillations you have got a ſufficient quantity of it, and then will ſerve for preparing the ſtrongeſt diſtill'd Vinegar for ſome particular uſes. I have always however found it tainted by corroding the Copper, for which reaſon it is dangerous to preſcribe it internally.

USE.

THIS diſtill'd Vinegar, is a ſaline, oily Acid, poſſeſſing the ſame vertues which we in the preceding Proceſs aſcribed to Vinegar; but as it is freed from its terreſtrial impurities, it is more penetrating, active, and volatile. The *Sapa* that remains in the Retort after $\frac{7}{8}$ths is drawn off by Diſtillation, is a moſt noble antiſeptic Medicine, uſed either internally or externally, but on account of its horrible Taſte, muſt be mix'd with a good deal of Sugar or Honey, as *Angelus Sala* obſerv'd in his *Oxyſaccharum:* For this *Sapa* is a true detergent acid Soap, which becomes continually more efficacious, in proportion, as it grows thicker, for by this means, it gradually grows of a more oily nature. By this Experiment, now, we learn, how wonderfully the diſtinct Elements of Bodies may lie concealed among one another; for who could believe, that after Wine was grown fine, it could contain ſo much of an oily Matter, as we ſee it depoſites in the making of Vinegar? Who, from Vinegar ſo thin and ſharp, could expect a black, oily, thick, inflammable *Sapa?* Or who could poſſibly imagine, that in the moſt limpid diſtilled Vinegar, which in thinneſs vies with Water, there ſhould be an inviſible pinguious Oil, and that too in great quantity? In the mean time, ſome of the niceſt Artiſts have obſerved, that if the acid of diſtill'd Vinegar is combined with Powder of Lead in ſuch a manner, as to produce the Sugar of Lead, it then coaleſces with that into a pinguious, tenacious kind of ſweet Sugar; and that if this is then gently dried, and diſtill'd in a Retort, it yields an oily Liquor that burns like Spirit of Wine. So that hence it ſeems as if the latent ſulphureous part, which was concealed in the thin Vinegar, diſcovers itſelf by this Operation, and is, as it were, regenerated. Unleſs you would rather imagine, that a combuſtible Oil is ſeparated from the ſoft metalline Body of the Lead by the Acid of the Vinegar, and conſequently that the inflammable Liquor drawn off, owes its origin intirely to the Metal. This however, I confeſs, does not ſeem probable to me, inſomuch as Lead, when it is corroded by the acid Spirit of Nitre, tho' it produces a rough ſweetiſh Vitriol in Diſtillation, yet as far as I know, does not yield ſuch inflammable Liquids, as it does when it is corroded by Vinegar. And then beſides upon the Mixture of the pureſt Spirit of Wine, with the moſt thoroughly calcined Salt of Tartar, there is regenerated an inflammable Liquid, as will evidently appear by another Experiment in the 66th Proceſs. Nothing, however, here, is more ſurpriſing, than that the exceeding acid *Fæces* of Vinegar ſhould afford an Alcali.

PROCESS LII.

The Rectification of diſtill'd Vinegar, per ſe.

APPARATUS.

TAKE any quantity of the diſtill'd Vinegar of the preceding Proceſs, No. 2. and with a gentle Fire, in a tall Cucurbit, draw off half the quantity. The half that comes off keep by itſelf, as do likewiſe that which remains in the Cucurbit. That which riſes will be light, limpid, watery, and leſs acid; whilſt that which remains after diſtillation, will be an exceeding ſtrong, ſharp, diſtill'd Vinegar, and heavier than the former.

USE.

THE Rectification, therefore, of Wine, and Vinegar, are effected in a quite different manner: In the former, the firſt volatile part is the beſt; in the latter, that which is more fix'd, and is left behind. Hence Vinegar, by boiling, is rendered ſtronger, and more ſharp; Wine by being boiled, becomes weak, thick, turbid, diſagreeable, and vapid. And for this reaſon, if Fleſh, Cartilages, Bones, and Skins, are boiled a great while in Vinegar, they are, by the action of the acid of the Vinegar, which is agitated, and grows ſtronger during the boiling, reduced at laſt to a thick liquid Matter. This ſtrong diſtill'd Vinegar is uſeful, in particular, in all Solutions of Metals; for theſe require a pretty ſtrong acid.

PROCESS LIII.

The Rectification of diſtill'd Vinegar by the help of Verdigreaſe

APPARATUS.

1. IF Plates of the beſt red Copper are corroded by the Spirit that exhales from preſs'd Grapes, after the Muſt is ſeparated, and they are grown warm, and emit a ſpirituous Vapour, there will be a Mould generated upon their ſurfaces of a bluiſh green Colour. This is ſcraped off, and ſav'd, and then the Plates are again treated in the ſame manner, by which means they afford more of the ſame Mould. This then being collected together, is called Verdegreaſe, which therefore is Copper corroded by this Spirit, and combined with it. And this cannot be ſucceſsfully prepared in any places, where there are not theſe *Fæces* of Muſt poſſeſſing ſuch a ſharp and penetrating Power. This Spirit, therefore, is not properly an acetoſe Spirit, but one rather of a middle nature, betwixt a true Acid, and a fermented vinous one. Take ſome of this Verdegreaſe then, that has an agreeable Colour quite through its whole Maſs, pound it, put it into a clean glaſs Cucurbit, and pour upon it ſuch a quantity of rectified diſtill'd Vinegar, as is ſufficient to cover it to the height of 10 inches. Set the Cucurbit in a pretty great Heat, *viz.* one about 150 degrees, and with a Stick keep the Mixture frequently ſtirring, and in a ſhort time the Spirit of Vinegar will be ting'd of a beautiful deep green Colour. Let it ſtand to ſettle, and then decant the clear Liquor very gently, without pouring off any of the bottom, and upon the *Reſiduum*, pour ſome more diſtill'd Vinegar, and digeſt it, ſtir it, and let it ſtand quiet, and decant as before. Repeat this Operation as long as the Vinegar continues to be ting'd, and then all theſe colour'd Liquors, mix'd together, are call'd a Tincture of Copper. When the Verdegreaſe will give out a Tincture no longer, there will be a great quantity of it ſtill left undiſſolv'd.

2. Let the tinctur'd Liquors be filter'd through Paper, and then be diſtill'd in a clean Cucurbit, with a Heat of 200 degrees, till a Pellicle begins to be formed on the very green Liquor that remains. The Fluid then that comes off will be limpid like Water, aqueous, and but little acid. Let the inſpiſſated Liquor be ſet by in a Cellar, and it will in a ſhort time ſhoot into moſt beautiful, green, pellucid Cryſtals, which will faſten particularly to the ſides of the Glaſs, and incruſtate it over. Pour off the remaining Liquor as nicely as you can from the cryſtalline Cruſt, which muſt be dried as gently as poſſible in a hot Air, and carefully ſeparated from the Glaſs, and ſo kept, that it may not be affected with too great a degree of Heat, for fear of its becoming opake. Let the decanted Liquor be again inſpiſſated to a Pellicle, and then formed into the ſame Cryſtals, which muſt be treated with the ſame caution as the former. And thus you muſt proceed, till by this means all the true Copper that was contained in the Verdegreaſe is reduced to theſe pure Cryſtals of Verdegreaſe, which in the Shops go commonly by the name of diſtill'd Verdegreaſe. If this is reduced to Powder, it gives a moſt beautiful green Pigment. If it is ſprinkled upon a foul Ulcer, it excites Pain, forms an Eſchar, and thus dries

up the Mouth of the Ulcer, whilſt at the ſame time an Inflammation is excited underneath, which ſeparates the Cruſt, by which means the worſt kind of Ulcers are ſometimes happily cured: For it is of the ſame nature as the Cauſtics, made with Mercury and Silver.

3. When you have got a ſufficient quantity of ſuch Cryſtals, put them into a glaſs Retort, and diſtill them with a Fire gradually increaſed, and you will have firſt a ſmall quantity of a watery Liquor, which muſt be kept by itſelf, or thrown away. When this is drawn off, there will ſucceed an acid, pinguious Liquor, which will run down in ſtreaks, is conſiderably heavy, and is the moſt ſaturated with an Acid, of all the Liquors that can by any Art whatever be prepared from Vinegar. *Baſil Valentine*, therefore, recommends this for the Solution of Pearls in his *Manuductio Medicinæ*; and *Zwelfer* being acquainted with this, boaſted of his *Acetum Eſurinum*, pretending to be maſter of the *Alcaheſt*, for which he was ſharply handled by *Tachenius*. When the Operation is over, there remains the Powder of the corroded Copper, which may be again diſſolved in diſtill'd Vinegar, and be form'd into green Cryſtals as before.

USE.

THIS fermented Acid is the ſtrongeſt that can be procured from Vegetables, and conſequently poſſeſſes the moſt excellent Vertues, both Chemical and Medicinal that can be expected from ſuch an Acid. As it is efficacious, therefore, in reſtoring an appetite where it is deſtroy'd by a Putrefaction of the Bile, or other Humours, hence it has obtained the name of *Acetum Eſurinum*, Hungry Vinegar. But in thoſe caſes, where the appetite is pall'd by a predominant acid, which the Phyſicians are ſenſible is often the caſe, there this only increaſes the cauſe, and ſo proves prejudicial. This Acid, however, by being mix'd with abſorbent, or alcalious Subſtances, will loſe its acid Vertues in the ſame manner as all others do, and therefore *Zwelfer*, who aſſerts the contrary, in this caſe muſt not be regarded. In order now to underſtand the proper effect of this Operation, we muſt obſerve, that diſtill'd Vinegar conſiſts of Water and an Acid: This Acid is attracted out of the Vinegar by the Copper, whilſt the Water is unaffected by it, and left by itſelf: The Acid then adheres to the Copper, and ſubſiſts with it in the form of a ſolid Body, and ſcarcely at all alter'd, till by the force of the Fire it is ſeparated from it in its former nature, and then it leaves the Copper reduced to Powder, but without any other alteration. This, now, as far as I have been able to inform myſelf, cannot be effected by any other Body but Copper; for Gold, Silver, Mercury, and Tin, are not diſſolved by it; and tho' Iron and Lead are, yet they change it in ſuch a manner, that a pure acetoſe Acid cannot be procur'd from them again, but ſomething of a very different nature. Hence then we ſee what a prodigious difference there is in Solutions; the Acid of Vinegar is attracted into Copper, and is thence procured again by Diſtillation, very little altered, being only freed from its watery part; Lead attracts the ſame Acid into it, and rejects the Water; and yet if you endeavour to ſeparate it by Diſtillation, you have an oily pinguious Liquor, of a quite different nature from that of Vinegar; and if Iron is diſſolv'd by the ſame Acid, it yields nothing again but Water, and ſurpriſingly altered.

tered. And as for other Abſorbents, or fixed or volatile Alcali's, if it is combin'd with any of them, it never returns back again a pure Acid: ſo that perhaps Copper alone, or Verdegreaſe made from it, is the only Body we are acquainted with, that is diſpoſed to ſharpen and exalt the pure Acid of Vinegar.

PROCESS LIV.

The Generation of Tartar from Wine.

APPARATUS.

1. WINES, made from Grapes in particular, eſpecially thoſe which have an acid, or rough Taſte, generally generate a pretty deal of Tartar. This however they produce good only, when their Fermentation is perfectly over, and they come to grow fine. And the pureſt of all is formed by them, when they are drawn off fine into another Caſk. It is procured in greateſt quantity from Wines that have ſtood quiet for ſome time upon their own Lees, and have in ſome meaſure gently conſumed them. The limpid white Wines yield the white Tartar, the beſt of which comes from the Rheniſh Wines, and is very white, and in large lumps, and is made uſe of for medicinal purpoſes: And here the whiter, heavier, more ſhining, and thicker, with reſpect to its Subſtance, it is, it is ſo much the better; See Proceſs 8. That from the red Wines is not ſo pure, is generally formed in Maſſes not ſo ſolid, and is of a more oily nature. Concerning all theſe ſorts, conſult again Proceſs 8.

2. This ſtony Salt of Wine, which is not in the leaſt diſpoſed to be diſſolved either in Water or pure Wine, but like a Stone remains without alteration, if it is boiled in a good deal of Water, will in ſome meaſure melt, and render the Water turbid, and in it you will perceive little ſhining Corpuſcles ſuſpended and ſwimming about. And thus even whilſt it is boiling, it caſts up continually a kind of Pellicle to the top, which being taken off with a wooden Spoon full of little Holes, and ſpread in a clean hot broad Veſſel, and there dried, forms a white fine Powder, which goes by the name of Cream of Tartar. And if you continue to take this off, as it is thrown up in boiling, the whole Body of the Tartar, except a few *Fæces* at the bottom, will be converted into this white acid Powder, or Cream of Tartar.

3. If you boil white Tartar in a very clean Veſſel with twenty times its weight of Water, or more, till it its thoroughly reſolved, and whilſt it continues boiling hot, pour it into a pure wooden Veſſel without any of its *Fæces*, then a Cruſt will immediately begin to form itſelf upon all the parts of the Veſſel where the Liquor can reach to, which will continually increaſe more and more, and thus in a ſhort time the whole Body of the Tartar which was diſſolv'd in the Water, will be form'd into regular ſhining Glebules, call'd Cryſtals of Tartar, which muſt be collected, gently dried, and kept for uſe; ſo that the Water that remains when it comes to be cold, will retain but very little of it.

4. Hence, therefore, we ſee, that this Salt, produced by a vinous Fermentation, is in theſe Properties intirely different from every other Salt in nature that we are acquainted with. This Cream now, or theſe Cryſtals, may, by being boiled in freſh Water, be again converted into Cream and Cryſtals; and by this

means your Powder will be always of a whiter Colour. Neither the Cream, however, nor the Cryſtals are more valuable for any chemical or medicinal uſes than the Tartar itſelf.

USE.

THE right underſtanding this and the eighth Proceſs gives us a good inſight into the nature of Fermentation, and this production of it, Tartar. It is this that affords that wonderful Salt, which in many caſes is of ſuch excellent ſervice. The Dyers, Silver-ſmiths, Chemiſts, and Phyſicians, make great uſe of it. The Chemiſts have a great many Preparations from it, and ſome of their moſt valuable too. In Medicine, it is of admirable ſervice in purging the firſt Paſſages, gently, if it is given in a ſmall Doſe, but very powerfully, if adminiſtred in a large one. But here you may conſult that very candid Chemiſt *Angelus Sala*, who has wrote exceeding well upon this head.

PROCESS LV.

The Reſolution of Tartar, by Diſtillation, into an acidiſh Water, a Spirit, an Oil, and a fix'd alcaline Salt.

APPARATUS.

1. TAKE a glaſs Retort, fill it two thirds full of the pureſt pieces of the beſt white Tartar, and place it in a Sand Furnace. Fix on a large glaſs Receiver, nay, if you are not afraid of fouling it in ſuch a manner that it will ſcarcely afterwards come clean, the very biggeſt you can get. Lute the Joint with a common Lute of Linſeed, and then give a gentle Fire, ſcarcely exceeding a 100 degrees, which muſt be continued for a conſiderable time. By this means then you will have a moderate quantity of a thin, limpid Water, which is acidiſh, ſomewhat ſpirituous, bitteriſh, a little odorous, and very penetrating, inſomuch that it will very eaſily preſpire through the Pores of the Lute: Let this be removed and kept by itſelf.

2. Your Fire being then increaſed to the Heat of boiling Water, there will riſe a whitiſh Vapour, and in that an exceeding penetrating Spirit, which is ſurprizingly flatulent, and is ſo vaſtly ſubtil, that it can ſcarcely be confined, but inſinuates itſelf through almoſt all ſorts of Lutes; and if we endeavour to keep it in with that very ſtrong one, called the *Lutum Sapientiæ*, by its elaſticity it burſts the Veſſels to pieces. And here it is remarkable, that this Spirit ſeems to act with a kind of *Impetus*, and remiſſion, and thus to perſpire, by blowing as it were through the Lute. But with this flatulent, ſylveſtrian Spirit too there immediately comes over a prodigious ſubtil thin Oil, which is of a yellowiſh Colour, has a kind of aromatic Smell that is not diſagreeable, and a bitteriſh Taſte, and is of a heating Quality. Nay, in this wonderful Oil I found ſuch an incredible penetrability, that though the Neck of the Retort went five inches into the Mouth of the Receiver, and the Joint was luted as cloſe as poſſible, yet this volatile Oil had returned back again betwixt the Retort and Receiver, and had ſo inſinuated itſelf through the Body of the Lute, that ſome of it dropp'd

down into the Plate underneath, whilſt ſome more of it ran down the outſide of the Receiver. Nor have I by any Art been hitherto able to prevent it; for if you make uſe of an impenetrable Lute, then the Veſſels burſt aſunder. I don't wonder, therefore, that *Paracelſus* and *Van-Helmont* ſhou'd ſo highly extol this Oil in Diſeaſes of the Ligaments, Membranes, and Tendons, which, upon experience they aſſerted they cou'd cure, even though they were come to be contracted.

3. Theſe Liquors being ſeparated and put by themſelves, urge the *Reſiduum* with a Sand-heat gradually increas'd to the greateſt, and you will ſtill have ſuch a Spirit and Oil as before, but at the ſame time, there will come over too, a thick, black, fetid, heavy, very tenacious, and bitter Oil. The Tartar then that remains in the Retort is black, acrid, and alcaline in every Quality.

4. If the remaining Maſs is then farther urg'd with the moſt violent ſuppreſſing Fire, there will ſtill riſe ſomething of a very thick, black, pitchy Oil, together with a Fume; and theſe will never ceaſe, increaſe your Fire to ever ſo great a degree, or protract your Operation ever ſo long. The *Caput Mortuum* then that is left in the Retort will be very black, vaſtly acrid, alcaline, and dry, and when upon breaking the Veſſel it is expoſed to the open Air, it immediately grows warm, and runs *per Deliquium*, nor can be kept dry without a great deal of Caution, though the Tartar from which it is produced will ſcarce ſuffer itſelf to be diſſolv'd in Water.

5. If this black dry Maſs is expoſed to the Fire in the open Air, it flames, and when it is burnt out, leaves a white, alcaline Salt, which is exceeding ſtrong, cauſtic, pure, and in the greateſt quantity that it can ever be procured. This affords but very little Earth, diſſolves ſpontaneouſly, and very readily, and if it is kept for a conſiderable time in a ſtrong Fire, it grows bluiſh, of a marble colour, and ſometimes brown, and by this means becomes always ſo much the more acrid, as we took notice before, when we were treating of Alcali's Proceſs 12.

USE.

IF there is any thing to be learn'd any where, there is certainly here. How wonderful is the Action of Fermentation? It firſt ſeparates all the thicker parts and leaves a liquid, ſubtil, limpid Wine. From this there is afterwards generated a Subſtance that is almoſt like Stone, and will not diſſolve in Water, whoſe Elements, therefore, muſt have lain concealed in this fine Liquor. And from this ſtony Concretion again are procured a Water, a Spirit, and an Oil, of ſuch various ſorts, ſo thick, and in ſo great quantity. In what part of the Wine now was this Oil contain'd, or where did it lie concealed? There was an Alcohol there, indeed, but nothing like ſuch an Oil. But there is ſomething in this Affair ſtill more ſurprizing, and that is, that though native Tartar is, both in its external and internal parts, merely acid, and cauſes an effervescence with Alcali's, as will evidently appear, Proceſs 75, yet purely by the Action of the Fire upon it, and that not a great one, and in a cloſe Veſſel too, the greateſt part of its Subſtance is converted from an acid diſpoſition to a true, ſimple, alcaline one, even without any conſiderable ſeparation of an Acid from it. And this, perhaps, is the only inſtance where a fixed alcaline Salt is generated by a moderate Fire, in a Veſſel into which there is no admiſſion of the Air; for in other caſes there is produced only a black, inſipid Coal: Who then cou'd have ſuſpected, that ſo plain an Acid cou'd by this means have been changed to an Alcali? If you take now the acid Water, the Spirit, and the Oils, and pour them back upon the remaining alcaline Maſs from which they were diſtill'd, and then diſtill them in the ſame manner as before, you will have ſcarcely any Acid, and but a little Oil, but almoſt all the Subſtance of the Tartar will be converted into an Alcali. Hence then we ſee, that a very acid Body of a conſiderable bulk may be eaſily changed into an alcaline one; whereas the converſion of a ſtrong Alcali into an Acid, has not, as far as I am acquainted with theſe things, yet appeared ſo evident. Hence, therefore, I cannot help being conſiderably ſurpriz'd, when I reflect on the very ſingular nature of this Tartar, which, to the beſt of my knowledge, in the whole compaſs of things, has nothing like it. As for the uſes of theſe various parts, the firſt diſtill'd Oil is wonderfully penetrating, and is commended for diſcuſſing cold Tumours, and for reſtoring Flexibility to the dry, tendinous parts of contracted Limbs, if at the ſame time they are properly aſſiſted by Baths, Fomentations and Friction. If theſe Oils are rectified, they become ſtill more ſubtil and penetrating, and are then extoll'd by the Chemiſts for reſolving even gouty Concretions. Many People ſay, that your rich perfum'd Balſams may be exalted by this Oil; but they ſay likewiſe, that the Smell of Muſk and Civet, when it is grown flat, may be quickened by the Fumes that riſe from a Privy. Salt of Tartar, now, is procured by this method in greater plenty, from the ſame quantity of Tartar, than by any other whatever, and always in a greater, as the Diſtillation is carried on more gently. And of all fixed Alcali's this is the moſt excellent, the acrideſt, the moſt penetrating, and the pureſt, nor is there any known Body in Nature which yields a greater quantity of this ſaline, alcaline Matter, than Tartar does. If the black Alcali, that thus remains from this vinous Subſtance after the laſt Diſtillation, is ſet by in the Retort, only ſlightly ſtopp'd with Paper, it will be intirely diſſolv'd into a Liquor, which being filtered through *Hippocrates*'s Sleeve, makes an excellent Oil of Tartar *per Deliquium*, that is exceeding fit for an infinine number of chemical Uſes, and ſerves admirably for ſome particular Operations. If the ſame Salt is burnt in an open Fire, and then ſtrongly calcined, and ſuffered to run in the Air, you have then too an Oil of Tartar *per Deliquium*, but a great deal more acrid and alcaline than the former.

PROCESS LVI.

Tincture of Gum Lac by the help of the Proceſſes 12, 55, 47, 48, 49.

APPARATUS.

1. THE Chemiſts have obſerved, that ſome Vegetable Subſtances are with difficulty diſſolved in Alcohol, and yet, when they are diſſolved in it, give evident proofs of their excellent medicinal Vertues. Of this kind are Dragon's Blood, Gum Juniper, Lac, Myrrh, and others, in which there is ſuch a wonderful tenacious Hardneſs, that they won't eaſily ſuffer a diſſolution. Af-

ter various methods, therefore, tried to incide and prepare theſe Bodies for a more ſpeedy and perfect ſolution, the following is found to be the moſt convenient. And here we ſhall give you an inſtance of it in Gum Lac, which comes from *Aſia*, and is a kind of Reſin which the Ants ſcrape off of the Trees, and by building their Neſts with it, collect it in great quantities, particularly in the Iſland *Ceylon*, from whence we have the beſt ſort. Take then ſome of the choiceſt and pureſt of this Gum, reduce it to a fine Powder, and ſprinkle it well with the alcaline Oil of Proceſs 12, or 55, ſo as to reduce it to a kind of Pap in a Urinal with a round bottom. Set the Glaſs in our Furnace, deſcrib'd Vol. I. p. 510, and apply ſuch a Heat to it as juſt to dry the included Matter. When it is dry take the Urinal out, and let it ſtand expoſed to the open Air, and you will have an alcaline Oil *per Deliquium*, which muſt be then dried again in the Furnace, as before. After the Solution and Exſiccation has by this means been repeated ſome number of times, the vitreous tenacity of the Gum is at laſt reſolv'd, and it is reduc'd to a Liquid of a moſt beautiful purple colour. This then muſt be gently dried again, and what remains muſt be taken out of the Glaſs, and will then be properly diſpoſed for the Extraction of a Tincture with Alcohol.

2. The Gum then being thus prepar'd, put it into a tall Bolthead, pour as much pure Alcohol upon it as will cover it to the height of three or four inches, and cloſing the Mouth ſlightly with a Paper Stopper, put it into the ſame Furnace, that it may be kept juſt ready to boil, for the ſpace of two or three hours. Nor need you be at all afraid of any inconvenience from the Veſſel's not being cloſe ſtopt, for the height and narrowneſs of the Neck will prevent any of the Alcohol's evaporating. Then let the whole grow cold, and by a gentle inclination pour off the pure ting'd Liquor from the ſubſiding Matter, and put it into a clean Glaſs, which muſt be well ſtopt. Upon the *Reſiduum*, then, you may repeat the ſame Operation in the ſame manner, and mix the ſecond colour'd Liquor with the former, and ſo proceed till the Gum won't give a Tincture to the Alcohol any longer, which will be then quite exhauſted, and good for nothing.

3. Theſe Tinctures being all put together, and depurated from their ſubſiding *Fæces* by ſtanding quiet, muſt be inſpiſſated to one half by evaporating the Alcohol with a gentle Fire in a glaſs Cucurbit, and are then admirably prepar'd for their proper uſes.

USE.

HERE then we ſee, that an Alcali, the Air, and a digeſting Fire opens a compact Body in ſuch a manner, that it afterwards ſuffers its Vertues to be extracted by Alcohol; that the reciprocal Action of humectation and exſiccation penetrates at laſt to the very inmoſt parts of it; but that ſtill there is ſome Matter in it, which is able to reſiſt even the efficacious Power of this alternate Operation, nor will be reſolv'd, but remains at laſt in the form of *Fæces*; and that theſe Tinctures therefore poſſeſs the active Vertues of ſuch Bodies, which are now freed from any impediment from the groſſer terreſtrial parts. This method therefore is efficacious, ſpeedy, convenient, and of very extenſive uſe in making the moſt beautiful Preparations. And here the general Vertues of the Tincture will depend, firſt, upon the *Spiritus Rector* of the Bodies from which they are extracted, which lies concealed in them, and often is endued with a ſurprizing efficacy; ſecondly, upon their balſamic pinguious part; thirdly, upon the corroborating reſinous part, which generally enters into their Compoſition; and fourthly, upon the diſſolving Alcohol, which we have particularly examined already. Hence, therefore, we may venture to pronounce of theſe in general, that they are heating, ſtimulate the Nerves, raiſe the Spirits, are drying, reſiſt Putrefaction, increaſe particular Powers, and conſtringe the Veſſels. As for this noble Tincture of Gum Lac, it is of excellent ſervice in Diſorders of the Mouth, Gums, and Teeth, in the Scurvy, if they are prudently rubb'd with it. If it is taken internally, too, it is a very good and ſafe Medicine in the ſame Diſtemper, as it don't excite too great a degree of Heat. In the Gout, the colder kinds of Rheumatiſm and Scurvy, leucophlegmatic, and dropſical habits of Body, and the like, it is uſed with great ſucceſs. And here it is beſt to clear the Stomach firſt, and then give it three times a day in *Spaniſh* or *Canary* Wine, when the Stomach is moſt empty. It has an agreeable Smell, and a bitter Taſte that is not unpleaſant, with an Aſtringency which ſufficiently indicates its corroborating Power. Hence where a mucous Humour is predominant, particularly in the uterine Veſſels, as in the Whites, it is extoll'd as an excellent Medicine.

PROCESS LVII.

Tincture of Myrrh by the help of the Proceſſes 12, 55, 47, 48, 49.

APPARATUS.

TAKE ſome choice Myrrh, and proceed exactly as in the preceding Proceſs, and you will have a truly valuable Tincture, which the Artiſts were long in ſearch of, but had always the mortification to ſee that this noble Gum would not remain diſſolved. A great many methods therefore have been tried of diſſolving it with various *Menſtruums*; but this ſucceeds the beſt.

USE.

HERE we have an inſtance of a Chemical Solution, in particular for Medicinal Purpoſes. *Van Helmont* formerly aſſerted in his Writings, that if Myrrh cou'd but inſinuate itſelf into the moſt intimate vital parts, it wou'd have a great tendency to lengthen out Life, ſo far as this cou'd be expected from the incorruptibility of the vital Balſam. If foul Ulcers of the Mouth, Noſe, Gums, and other parts of the Body are waſhed with this Tincture, by its detergent and antiſeptic Vertue, it proves of excellent ſervice in healing them. If the Bodies of dead Animals are thoroughly penetrated with it, firſt made hot, they are preſerved from Putrefaction. Internally it is of admirable uſe in *Languors* from a ſimple *Inertia.* To the Fair Sex in particular it is greatly ſerviceable in thoſe Diſtempers which are owing to a watery, mucous ſluggiſhneſs of the Fluids, and a too great laxity and weakneſs of the Solids, which they are naturally diſpoſed to from the ſoft looſe make of their Bodies, eſpecially in the *Uterus*, which is the moſt dilatable part of all: In that mucous uterine diſcharge, therefore, called the *Fluor Albus*, it has an excellent effect, and hence cures all thoſe Diſorders that depend upon it.

PROCESS LVIII.

Tincture of Amber by the help of the Proceſſes 12, 55, 47, 48, 49.

APPARATUS.

TAKE ſome choice pieces of the cleareſt, pureſt, yellow Amber, and reduce them to a very fine, mealy Powder. Rub this well with the alcaline Oil of Proceſs 12, or 55, the longer the better, till it is brought to the conſiſtence of a very uniform Pap. Put this liquid Matter into a clean Urinal, and dry it gently in the ſame Furnace, and then let it run in the Air, and dry it again as in the two preceding Proceſſes, and repeat this a pretty many times, for it is penetrated with a great deal of difficulty. The Matter being at laſt well dried, put it into a Matraſs, with a very long ſlender Neck, and pour as much pure Alcohol upon it as will cover it to the height of three inches. Shake them well together, and then let them boil gently in the Furnace, for the ſpace of ſome hours, which here may be done without any inconvenience. By this means then you will have a red Tincture. When this is grown cold and clear by ſtanding, pour it off gently into a clean Veſſel, and ſtop it very cloſe. Then proceed in the ſame manner as before, till the whole ſubſtance of the Amber is almoſt conſumed into ſuch a Tincture. A Tincture may be prepared by the ſame method with Alcohol alone, without any Alcali; but this with an Alcali is better.

USE.

HERE then we ſee the efficacious Power of an Alcali, which thus procures an entrance for the Alcohol into a Body that is brittle like Glaſs, and whoſe ſingular and ſurprizing reſinous Nature no body has hitherto clearly explained. A foſſil Acid, indeed, and *Petroleum*, or ſomething of the like nature ſeem to enter into its Compoſition, which is not reſolved without a great deal of difficulty. This Tincture, however, is neither acid, alcaline, nor oily, but contains the whole Subſtance of the Amber diſſolved, with a refreſhing, aromatic, bitteriſh Taſte, ſome aſtringency, and a fragrance that is wonderfully reviving. If it is well made it grows turbid in the Winter, and depoſites a mealy and kind of reſinous Matter, and thus evidently demonſtrates how pregnant it is with the diſſolved Amber: As the warm Weather, however, comes on, it grows pellucid again, and takes up what was ſeparated from it before. If from this Tincture you draw off half the Alcohol, the remaining thick Matter will let fall a kind of mealy Powder of Amber, which is of an exceeding aromatic Smell and Taſte. It is ſurprizing here, now, that this Body ſhou'd almoſt all of it be ſo equably diſſolved in the Alcohol without any conſiderable ſeparation of its Elements, and yet ſhou'd acquire ſuch noble Medicinal Virtues, which did not diſcover themſelves before in the Amber itſelf; eſpecially as by diſtillation it is divided into ſuch various parts, of ſuch different Qualities and Vertues, as will appear in Proceſs 86. Hence then we have another evident proof that there is an incredible diverſity in chemical productions, as they are prepared with different *Menſtruums*, and by different Methods. Hence we ſee farther too, that the moſt different Elements may lie intirely concealed in a compound Body, without the leaſt diſcovery of their nature or preſence, and that, though they are very ſubtilly divided by rubbing, or by a *Menſtruum.* And hence, laſtly, it appears, how the ſole diviſion of a Body brought about by a *Menſtruum* may produce new Vertues in it without any ſeparation of its Elements. This Tincture now is of admirable ſervice in all thoſe diſorders which ariſe from too great a mobility of the *(inſtrumentum proximum)* moſt immediate Inſtrument of the human Affections, *viz.* the Spirits, and nervous Syſtem, to the production of which, a weak habit of Body has a particular tendency. Hence in hypochondriacal, hyſterical, languid, cold, watery, pituitous, leucophlegmatic Caſes, Catarrhs, and Convulſions that are often cauſed by theſe Diſorders, it is an excellent Medicine. And for this reaſon both *Helmont* and *Boyle* rank'd it amongſt the moſt efficacious Antiſpaſmodics, and Antileptics, where they were owing to this Cauſe. Theſe three inſtances then are ſufficient to let you into the true method of extracting Tinctures from thoſe Subſtances which give them out with the greateſt difficulty. The Doſe, now, and Method of uſing this Tincture are the ſame we gave you Proceſs 56.

PROCESS LIX.

Tincture of Benjamin by the help of the Proceſſes 47, 48, 49.

APPARATUS.

IF this noble reſinous Body, which ſpontaneouſly diſtills from its Tree in great abundance, is reduced to Powder, and without any preparation boil'd in a Bolthead with Spirit of Wine once rectified, it will be preſently diſſolv'd into a red ſweet-ſcented Liquor. If the pure ſolution is then poured off, and the *Reſiduum* is treated again in the ſame manner, and ſo on, almoſt all the Benjamin will be diſſolved, a few *Fæces* only being left at the bottom. If you boil Alcohol with it in the ſame manner, the Tincture becomes ſtill ſtronger. Both of them have a ſweet Smell, and a warm, bitteriſh, balſamic Taſte.

USE.

HENCE it appears, that a reſinous, pinguious Body may be intirely diſſolved in Alcohol, and make with it a Liquor that is pretty thin, and homogeneous. If a little of this Liquor is poured into a good deal of Water, the Mixture grows white, opake, and milky, and is called *Lac Virginis*, becauſe, if it is uſed as a Waſh, it ſoftens the Face, and if it is ſuffered to dry on, it covers it with a very fine, beautiful Pellicle. Hence it is reckoned amongſt the innocent Coſmetics, and is ſometimes on account of its grateful Smell uſed by the Barbers in ſhaving. This Reſin of Benjamin, and Camphire, are wonderfully volatile, and, without the aſſiſtance of an Alcali, ſpontaneouſly diſſoluble in Alcohol, in a gentle degree of Heat.

PROCESS LX.

Tincture of Guaiacum-wood by the help of the Proceſſes 47, 48, 49.

APPARATUS.

1. TAKE ſome very fine Raſpings of the choiceſt, heavy, freſh, green Guaiacum-wood, or rather the Powder of its Bark, put it into a tall Bolthead, and pour upon it enough rectified Spirit of Wine to cover it to the height of four inches, without the addition of any thing elſe. Boil them together, in the manner already explained, for the ſpace of four Hours, frequently ſhaking the Glaſs. By this means then there will a red Liquor ſwim at top, which, after it has ſtood and ſettled, ſtrain carefully through a Cloth, and keep by itſelf. Pour ſome freſh Spirit on the *Reſiduum*, and treat it in the ſame manner, and ſo proceed, and when all the Tinctures are properly depurated, mix them together, and you will have a Liquor of a very penetrating, warm, aromatic Taſte and Smell. If you make uſe of Alcohol for this purpoſe, inſtead of rectified Spirit of Wine, the Tincture will be ſo much the better.

2. When this Tincture is prepared with pure Alcohol, draw off the Spirit with a gentle Fire, in a tall Cucurbit, till there remains but one quarter, which will be a very rich Tincture, ſtrongly impregnated with the Vertues of the Guaiacum. If there is a watery Phlegm in the Spirit made uſe of, then, if you inſpiſſate it ſo far, the Reſin will begin to precipitate, but if you draw the Tincture with the pureſt Alcohol, it will bear this inſpiſſation without any ſeparation of its parts, and at the ſame time will increaſe in its Strength.

USE.

IN this Operation then you ſee the method by which the oily, reſinous, balſamic part may be extracted from ſweet Woods, which may then be preſerv'd for medicinal purpoſes. The Liquor thus produced, too, is valuable on account of the Reſin that may afterwards be procured from it. The Vertues of theſe Tinctures depend upon the proper Qualities of the Woods they are extracted from, ſo far as they reſide in their aromatic, balſamic, oily, reſinous part. Hence, from Aloes-wood, *Calambac*, Snake-wood, Roſe-wood, Saunders, and the like, by this method, and with this ſolvent, are prepared Tinctures of excellent Vertues. This Tincture of Guaiacum, externally applied, is of wonderful ſervice, where there is any thing fungous, mucous, or virulent, in venereal and other malignant Ulcers, whether their ſeat is in the Skin, and *Membrana Adipoſa*, or in the Mouth, palate, *Fauces*, or Throat.

PROCESS LXI.

Tincture of Scammony by the help of the Proceſſes, 47, 48, 49.

APPARATUS.

THE thick, pinguious, milky Juices which ſpontaneouſly diſtill in great plenty from ſome Plants when they are wounded, after they come to be inſpiſſated by the Heat of the Air, or Sun, generally diſcover ſomewhat of Reſin in 'em. Of this kind are Lettice, Gum-ſuccory, Sow-thiſtle, Hawk-weed, Dandelion, Vipers-graſs, Goats-beard, Succory, Spurge, the Euphorbium, *Convolvuli*, Poppies, and the like. Theſe Juices then being dried and reduced to Powder, muſt be boil'd in the ſame manner in a Bolthead with Spirit of Wine, either once or twice rectified, by which means they will be almoſt all diſſolved, leaving but a little terreſtrial *Fæces* behind. And thus we draw a Tincture from the Scammony of *Syria*, which is the inſpiſſated Juice of a *Convolvulus.*

USE.

Tincture of Scammony prepared in this manner will purge in a ſmall Doſe, *viz.* two drachms mixed with three or four times as much Syrup of Damaſk Roſes; and from this is generally prepared the Reſin of Scammony. The inſtances now we have given in theſe three laſt Proceſſes diſcover to us particularly the Action of pure Spirits of Wine upon compound vegetable Subſtances, which proceeds according to the Law obſerved by the ancient Chemiſts, *viz.* that Spirits diſſolve that which is like them; for Alcohol that is abſolutely pure extracts from dry vegetable Bodies, Spirits, Balſams, Oils, Colophonies, Reſins, Gum Reſins, and perfect ſaponacious Subſtances, leaving a pure, dry Salt, and an Earth behind. When the Operator, therefore, knows that all the particular Vertues which he wants to extract from theſe Bodies, reſide in theſe parts, then the Tincture ſhou'd be made with the pureſt, and moſt perfect Alcohol, as we obſerved in the Tincture of Guaiacum: But on the other hand, when theſe Vertues are lodg'd in the oily, reſinous, ſaline, and ſaponaceous parts together, it is better to make uſe of common rectified Spirit of Wine, than Alcohol, for that acts by its watery part upon the ſaponacious ſaline Matter, and by its ſpiritous, upon the balſamic, oily, and reſinous, and conſequently in ſuch a Tincture you have their Vertues united together. This is evident in the Root of Hellebore, Hermodactils, Jalap, Mechoachan, and Turbith; for the Tinctures extracted from theſe with Spirit of Wine once rectified, purge much better than thoſe made with ſimple Alcohol. Thus if you draw a reſinous Tincture from Jalap with Alcohol, it is leſs efficacious, and there will ſtill remain a purging Quality in it, which may be got out of it by boiling it in Water; if you extract one with common Spirit of Wine, it purges more, and the *Reſiduum* is hardly good for any thing. From what has been obſerved then we infer, that a fixed alcaline Salt is not neceſſary in many Tinctures, nay, that it wou'd deſtroy or alter their Vertues; and that they are not always to be extracted with Alcohol: In theſe caſes, therefore, we muſt always firſt carefully conſider what ſort of Spirit is to be made uſe of. All theſe Tinctures, now, that are made with pure Alcohol, generally burn away intirely like ſimple Alcohol, and thus evidently demonſtrate, that the inflammable part only is here extracted from the Compound, all the reſt being left behind. When the peculiar Vertue of a Vegetable, therefore, reſides in the ſaline, ſaponacious part alone, then a Decoction of it in Water is better than in Alcohol. Opium is beſt of all diſſolved in Water, then in Wine, and next in Spirit of Wine, and is always ſo much the worſe, as the Spirit is ſtronger.

PROCESS LXII.

A Purging Potion from Proceſs 61, *and a Sudorific one from* 60.

APPARATUS.

IF, as I obſerved before, you take two drachms of Tincture of Scammony well prepared with rectified Spirit of Wine, and mix it with three times as much of any purging chologogue Syrup, as *Syrupus de Rhabarbaro, Cichorei cum Rheo, Roſaceus ſolutivus ſimplex*, or with Sena, and give it upon an empty Stomach to a pretty ſtrong Perſon, who wants this particular ſort of purging, it generally anſwers the end very well, by clearing away the Bile. Or if you take four drachms of ſuch a Tincture drawn from the choiceſt Jalap with common Spirit of Wine gently rectified, and add to it half an ounce of *Syrupus de Spina Cervina*, you will have a Potion, which will purge off a vaſt quantity of thin Water, without any conſiderable ruffle or inconvenience. In thoſe diſorders therefore where this kind of purging is neceſſary, it proves an excellent Hydrogogue. Theſe Tinctures therefore are generally kept in the Apothecaries Shops for any extemporaneous preſcriptions. But again, if you take four drachms of Tincture of Guaiacum prepared with pure Alcohol, and then inſpiſſated to one half, and mix with it four times as much *Syrupus quinque radicum aperientium, de Artemeſia Fernelii*, or the like, and give it to a patient faſting, and in bed, it commonly ſoon diſperſes itſelf all over the Body, heats it, puts it in motion, and diſpoſes it to ſweat pretty plentifully. And hence it is commended in venereal diſorders, that ſpread themſelves through the ſubcutaneous parts of the Body. And laſtly, ſuch a Potion prepar'd with Tincture of Snake-wood, and given in the ſame manner a little before the cold fit of an intermittent, has often an excellent effect, by promoting Sweat, heating the Body, and diſſipating the Cauſe before it has formed the Fit. The effects of other Tinctures may hence be eaſily underſtood.

USE.

THE Vertues of a great number of Vegetables reſide in their Reſins. And theſe are generally tenacious, and by this property are ready to fix and adhere to particular parts of the Body: At the ſame time too by their tenacity they are either rendered ſlow in their Action, or prevented from exerting it efficaciouſly; but when they are diſperſed through the vegetable, ſpiritous *Menſtruum* deſcrib'd, they act quicker, paſs ſooner, and operate in a great deal leſs Doſe. Theſe Reſins, however, when they are diſſolved in Spirits, are ſo acrid, that they can't be drank alone, and yet if you offer to dilute them with Water, there is immediately a tenacious Matter precipitated to the bottom. Nothing, therefore, is better to mix them with, than a thick Syrup, in which they will not precipitate; nor will they, on account of its wonderful ſimplicity, be at all altered, or loſe any of their proper Vertues by this Mixture, though at the ſame time they will by the thickneſs and ſweetneſs of the Syrup be rendered much milder.

PROCESS LXIII.

A Lac Virginis *from Proceſs* 59.

APPARATUS.

IF the very red Tincture of Benjamin, rightly prepared according to Proceſs 59, is examined, even with a Microſcope, it appears uniformly pellucid; but if you let fall a drop of it into Water, it immediately grows white, and opake, and produces ſome Films, that are diſcernible by the naked Eye, but more ſo if looked at with a Glaſs. If any quantity of this Tincture therefore is mixed with ten times as much Water, it grows preſently milky, turbid and full of Flakes, and almoſt all the Benjamin is precipitated to the bottom, in form of a fine mealy powder, ſo that there remains very little either of its Taſte or Smell.

USE.

THIS Experiment then ſerves to diſcover to us the nature of Reſins, with regard to Alcohol and Water; that of the white precipitation of an oily Body in Water (Proceſs 15, 16, 17, 21, 26, 27, 28, 29;) the production of a Reſin, by an Extract made with Spirits; and the ſeparation of this Reſin again from the Spirits, by the help of Water. This reſinous Matter now that ſubſides in the Water, preſents to the view ſome very ſubtil, ſmooth Pellicles, which, being rubb'd upon the Skin, render it ſleek and ſoft, and at the ſame time make it look beautifully. Hence it is made uſe of to waſh the Face with, where there are Puſtules, little Ulcers, Freckles, or the like Blemiſhes.

PROCESS LXIV.

Reſins procur'd from Proceſs 60, 61.

APPARATUS.

1. TAKE a Tincture drawn from an oily reſinous Vegetable with Alcohol of Wine, according to Proceſs 60, 61, and when it is grown very fine by ſtanding quiet, let it be inſpiſſated with a gentle Fire in a Cucurbit, till there is only one fourth part remaining; and here the Alcohol that is drawn off, if it is ſav'd, will ſerve again for the ſame uſe. Pour the inſpiſſated Tincture into twelve times as much clean Water, contain'd in a low Veſſel, that has a Mouth big enough to admit one's Hand. The Mixture, then, in an inſtant will grow turbid, and white, and will preſently diſcover ſome yellow Corpuſcles, which being collected at the bottom form a thick, tenacious, pinguious Matter, which is ſub-pellucid. Put the whole into a Cucurbit, and with a very gentle ſand heat draw off the remaining Alcohol with an Alembic, and proceed in this Operation as long as the Streaks in the Head make it appear, that the inflammable Spirits ſtill aſcend. The Spirit that comes off mix with that which you drew

off before, and there will then remain only the Water, and at the bottom of it the Matter juſt deſcribed, which will melt with the heat of the Water, and afterwards grow hard.

2. Throw away the Water, in which, tho' there will be ſome Smell and Taſte, yet there will be but very little Vertue. At the bottom, let the reſinous Matter collect itſelf into one Maſs, which you'll eaſily unite together, and which at firſt will be ſoft and flexible, and will ſtick to your Fingers, ſo as to be troubleſome. When you have waſh'd it, however, ſome number of times with freſh cold Water, it gradually grows ſtiff as it cools, and being dry'd, forms a hard, brittle, pellucid Body, which ſoftens and runs with Heat, will not diſſolve in Water, but may be diluted with Oil, or Alcohol, and burns like Oil in the Fire. This is what goes by the name of a Reſin, and muſt be kept in a cold dry place, and in a clean, dry, cloſe Veſſel. This may be procured, by this means, from almoſt any vegetable Subſtance that is oily, heavy, dry, and reſinous. Nature often ſpontaneouſly produces the ſame thing from Vegetables, but never more perfectly than in the Camphire-tree, which furniſhes us with a pure, white, clear, fragrant, volatile Reſin, but which is with difficulty reduced to Powder. From the Benjamin-tree too there oozes out a pure volatile Reſin, in pretty conſiderable quantity. But when pure Alcohol, now, is made uſe of to extract Tinctures from Vegetables, that are reſinous indeed, but at the ſame time juicy and green, then the Water that abounds in theſe Juices mixes itſelf with the Alcohol, ſo that hence it becomes diluted, and of conſequence acts like common or rectified Spirit of Wine, according to the greater or leſs quantity of Water that is ſupplied by the Plant. In this caſe, therefore, its Operation will be different from what it is, when the Body is dry.

U S E.

1. THIS Experiment, then, which is a pretty general one, teaches us the nature of Reſin, which ſeems once to have been a pure thin Oil, in the Vegetable, according to Proceſs 34, 35, and what we there took notice of concerning the origin of inſpiſſated Oils. Hence the Chemiſt learns the various appearances under which Oil is capable of ſubſiſting, as it is affected by different degrees of Heat or Cold: In a certain degree of Cold, it is a hard, brittle Reſin; when it comes to be expoſed again to Heat, it diſſolves into a pure fluid Oil. Some Chemiſts, indeed, have aſſerted, that Reſins are produced by the combination of a ſtrong Acid with a limpid Oil, as they obſerved that the very ſtrong cauſtic Spirit, both of Nitre and Vitriol, upon being mixed with ſuch an Oil, forms a pitchy tenacious Maſs, which by the help of the Fire, may be farther perfected into a Reſin: And hence they ſaid, that Sulphur itſelf, being generated in this manner, is a true Reſin of the Earth. There is a great deal of reaſon, however, to doubt, whether the Reſins we are ſpeaking of are formed by a coagulation of an Oil with an Acid, inaſmuch as in the natural Alteration of Balſams into Reſins, the Acid is more and more ſeparated from the Balſam, as that from its liquid State grows gradually thicker, and harder, and at laſt, when it comes to be hardened into a Reſin, there is ſtill leſs Acid in it, than when the Maſs continued ſomewhat liquid. Nay farther, too, the Reſins that are thus produced by the mixture of an Oil with an Acid, are always

ways different both from thoſe which nature ſpontaneouſly furniſhes us with, and thoſe which are procured from Vegetables by the help of Alcohol; for theſe laſt will diſſolve in Alcohol, whereas Sulphur is not affected by it.

2. In the Reſins thus prepared, which by the inflammability of their whole Subſtances, diſcover their perfectly oily Nature, there ſeems to reſide the original *Spiritus Rector*; for the Smell, Taſte, and particular Vertues are found ſtill to remain in this reſinous Subſtance, that is to ſay, thoſe which are lodg'd in the oily part of the Vegetable. And hence, theſe being entangled in the tenacity of the Reſin, may be ſecured for years, whereas they would be diſſipated ſooner from the Vegetable itſelf. But from the viſcidity of theſe Reſins it often happens, that when they are taken into the human Body, they paſs through intire, without giving out their Spirits to perform their proper Operation, not meeting with Bile enough, or any other ſaponacious Liquid to diſſolve them, and render them efficacious. By this means the Phyſician is frequently diſappointed, when theſe are ordered in Pills, as they are then often diſcharged whole by Stool, without the expected ſucceſs. In theſe Reſins too there is generally a manifeſt, acrid, cauſtic, inflammatory Power, ſo that if they ſtick to the Tongue or *Fauces*, by their Acrimony they prove very troubleſome, and in the Stomach and Inteſtines have the ſame effect, irritating, and inflaming the parts, and thus doing a great deal of miſchief. Hence, when theſe Reſins are prepared from *Coloquintida*, Spurge, *Euphorbium*, Hellebore, Jalap, *Mechoacan*, Scammony, or Turbith, they ſometimes bring on a dangerous *Hypercartharſis* that is not eaſily ſtopp'd. That both theſe inconveniencies therefore may be avoided, let theſe Reſins be rubb'd for a good while with an equal quantity of Loaf Sugar in a cold glaſs Mortar, and when they are reduc'd to a very fine Powder, let them be given in any Syrup, and then they will never paſs through the Body undiſſolved, nor will ever adhere to the Folds of the Stomach or Inteſtines, but performing their proper office eaſily and expeditiouſly, will prove an excellent ſort of a Medicine. Or if they are well rubb'd and divided with a little Yolk of Egg, their tenacity will by this means too be deſtroy'd, and their Operation will be rendered quicker and more efficacious. And by theſe Methods, even thoſe Reſins will purge, which are procured from Vegetables that have no purging quality, as we ſee plainly in the Reſin of Guaiacum.

3. The greateſt Maſters in the Chemical Art, long ago informed us, that diſtill'd aromatic Oils, that are very pregnant with Spirits, will grow reſinous when their Spirits are ſeparated from them; and this, in ſome of them, is evidently confirmed by obſervation: For if the pureſt Oil of Cinnamon is diluted with Alcohol, and this is intirely drawn off again by Diſtillation with a gentle Fire, then the Alcohol will carry off the Spirits along with it, and the Oil will remain at the bottom exhauſted, and at the ſame time inclining towards the nature of a Reſin.

4. But as the purging qualities of ſome Vegetables reſide partly in the Reſin that is extracted from them by Alcohol, and partly in another active principle which is diſſoluble in Water, as appears plainly in Jalap; hence, if after you have drawn out all the reſinous part with Alcohol, you boil the *Reſiduum* in Water, you will by this means obtain the other likewiſe. If you inſpiſſate this Decoction therefore, and reduce it to an Extract, and then mix it thoroughly with the Reſin rubbed according to Art with ſome Yolk of Egg, you will

then have an excellent Compound, which in a ſmall compaſs will poſſeſs almoſt all the purging quality of the Vegetable.

PROCESS LXV.

Extracts call'd Eſſential ones, from Proceſs 48: An inſtance here in Saffron.

APPARATUS.

1. NATURE often, in particular parts of Vegetables, generates a certain kind of Matter, which is of ſo different a nature from every thing elſe, that it can ſcarcely be reduced to any *Genus* of known Bodies, and at the ſame time poſſeſſes very excellent and inimitable Vertues. Of this ſort, is that Matter which is contained only in the gold coloured *Stamina* of Saffron. This, the principal of the Chemiſts have had ſuch an Opinion of, that they called it the *Aroma Philoſophorum*, and by combining together the firſt Letters of both Words, ſometimes ſimply, *Aroph*. And indeed, it is incredible how rich this is in Colour, Smell, Taſte, and Vertue, how ſmall a compaſs it takes up notwithſtanding all its excellencies, and how tender it is, and eaſily corrupted. For this reaſon, therefore, it deſerves a particular manner of Treatment.

2. Take, then, of the choiceſt freſh *Engliſh* Saffron, dry'd, and either cut ſmall, or whole, as you have a mind, two ounces, as I have here done before you. Put it into a very clean Cucurbit that has a long narrow Neck, and pour upon it as much of the pureſt Alcohol, in which you are ſure there is nothing heterogeneous, as will riſe to the height of 4 or 6 inches in the Body of the Bolthead. Stop the Mouth of the Glaſs lightly with a conical paper Stopper, and place it in our little wooden Furnace, with a live Coal under it, ſo covered with ſifted Aſhes, that it may give out a Heat only of 100 degrees. Let it digeſt in this manner for the ſpace of three days, every now and then ſhaking the Veſſel; and then let it ſtand quiet in a cool place for 24 hours, after which you may ſtrain it through a thin Cloth placed in a Funnel, and thus you will have a ting'd Liquor of a very bright Colour, which put into a glaſs Veſſel, and keep ſtopt very cloſe. The Saffron at the bottom of the Cucurbit you will then find paler than it was at firſt, upon which pour the ſame quantity of Alcohol, as before, and treat it in the ſame manner, and you will have another Tincture, which mix with the former: The Saffron by this means will be grown ſtill paler. If you have a mind then, as I have ſometimes done, to proceed any farther, pour more Alcohol on, and digeſt, *&c.* as before, and you will have a third Tincture, which will not be ſo rich, and which you muſt keep by itſelf: The Saffron will then be pale, but will have the ſame form and ſize as before. Upon this I once poured Water, and digeſted and decanted it, and the Liquor was of a yellowiſh Colour, which being ſeparated, I put on more Water, and proceeded in this manner, till it would extract a Tincture no longer. The *Stamina* were then of an exceeding white Colour, and being gently dry'd, retained their proper Figure, but were thinner a good deal than at fiaſt, and had neither Smell nor Taſte, nor were eaſily to be diſtinguiſhed from Threads of pure Flax. It is ſurprizing, therefore, to conſider, in what place this wonderful Matter ſhould reſide, which as appears by this Operation, may be richly diffuſed thro' ſo large a quantity of Alcohol.

3. Let the Alcohol in the two firſt Tinctures be gently drawn off in a glaſs Cucurbit, with a Heat of 100 degrees, till there remains about an ounce at the bottom, keeping the Veſſels very cloſe. When this is cold, let it be poured into a Vial, and ſtopp'd as nicely as poſſible. This Liquor will be of a very red Colour, an exceeding fragrant Smell, and a bitter, aromatic, penetrating Taſte, and of the Conſiſtence of a liquid Oil; and then it is called the Extract of Saffron. The Spirit that riſes in Diſtillation, will be very limpid, diſcovering no manner of Colour, but having a fine aromatic Smell of Saffron, and ſomewhat of the Taſte: This, therefore, I always ſet by for the ſame uſe, and by this means it becomes conſtantly more and more impregnated.

USE.

1. THIS ſurprizing Experiment diſcovers to us a new kind of Matter, which we can ſcarcely call an Oil, Spirit, Gum, Reſin, or Gum-Reſin; nor is it a Wax, or a Balſam. What then ſhall we ſay of it? Why certainly it is ſomething of a particular kind, but of an oily ſpirituous nature. The Extract prepared in this manner, ſuffers itſelf to be mixed with Water, Spirits and Oil: And its Vertues have ſuch a ſingular reviving quality, that the immoderate uſe of it is apt to excite an extravagant, nay indecent Mirth, but a prudent one renders it truly exhilarating. It is ſaid to have a peculiar power of deſtroying the petrifying quality of the Urine in the Kidneys, and of conſequence to be an excellent Remedy againſt the Stone. This is the true *Aroph* of *Paracelſus*: Nor is it neceſſary to mix the Saffron with Bread, and let it corrupt with the Heat of Horſe-Dung, in order to extract a Tincture from it, for by this means it is worſe rather than better; whereas in this Preparation of ours, we retain the whole, without any loſs, without any diminution of the proper Vertues, or without any ſenſible alteration. Theſe Extracts now have this excellence, that they may be mixed almoſt with any thing, and are of ſo exceeding ſubtil a nature, that they are capable of inſinuating themſelves into the minuteſt Veſſels of the Body, and at the ſame time are ſo very mobile, that they diffuſe their Vertues through the whole human Frame, tho' they act particularly upon the animal Spirits, and put them into motion. And then beſides, they have thoſe peculiar Vertues which the All-wiſe Creator has implanted in the particular Bodies they are made from, and which are diſcovered only by their proper effects, nor can be explained from any other principle whatever.

2. Ambergreaſe, Muſk, Civet, Caſtor, Opobalſam, Balſam è Mecha, Liquidambar, Liquid Storax, Garden Cloves, Aromatic Cloves, Mace, Nutmegs, Angelica, Galangals, Maſter-wort, Florentine Orris, and Barks and Leaves that have a very fragrant Smell, yield the ſame kind of Extracts, if they are treated in the ſame manner. So that hence it evidently appears, that the Spirits of particular Bodies may be drawn out and collected together by the help of Alcohol. And for this reaſon, their Vertue ſeems moſt readily to be brought into action by this Operation; for the Alcohol which is exceeding ſpirituous, by being united with theſe very active Spirits, produces a Medicine which very ſoon diſperſes its efficacy through all parts of the Body.

3. And when from a number of ſuch Bodies as are above deſcribed, you prepare the ſame Medicine, it eaſily appears, that according to the pleaſure of the

Operator, various kinds of the moſt beautiful Compounds may be formed, which by their united Vertues will become ſo much the ſtronger, ſo that nothing can be contrived that ſhall be more efficacious. Theſe Extracts are beſt taken in Canary, or ſome ſuch oily Wine.

PROCESS LXVI.

Eſſential Extracts from Camphire, by the help of Proceſs 48, 49.

APPARATUS.

THIS ſurpriſing kind of Body, which we have more than once taken notice of already, deſerves to be ſtill farther examined in the following hot manner. Camphire, then, in the very Countries, is found to reſide naturally in the Wood, but more particularly the Bark of the Camphire-tree in a true cryſtalline Maſs; of which that in the Iſlands *Borneo* and *Ceylon* is the fineſt, and moſt valuable. Another ſort is procured by diſtilling the Wood, Bark, and Root of the Camphire-tree, or of the *Ceylon* Cinnamon-tree that has the Smell of Camphire, for theſe Bodies being digeſted in Water, and diſtill'd, yield a limpid, and very penetrating Oil, which is ſtrongly impregnated with the Smell and Taſte of Camphire, and part of which hardens into Camphire when it comes to grow cold. This wonderful Subſtance is depurated by Sublimation, in a clean Veſſel, with a gentle Fire. It is clear like cryſtal, difficult to powder, very odorous, and is ſpontaneouſly volatile, and will all exhale away. In Alcohol it will intirely diſſolve, and this will ſtill remain perfectly pellucid, and will by this means acquire a very fragrant Smell. If you then diſtill this Mixture, almoſt all the Camphire riſes with the Alcohol, or a very little after it, in form of a homogeneous Liquid. And if you drop a little of this very limpid Liquor into Water, it immediately grows white, and the Camphire appears again in the Water in its proper form. Thus then you ſee that this heteroclite kind of Body reſembles a Reſin, but a volatile one; in which reſpect, therefore, it differs from others. It may be diſſolved too in Spirit of Nitre, Spirit of Vitriol, or *Aqua Fortis*, in the ſame manner as it is in Alcohol. But where again do we find this to be the caſe in other Reſins? Hence, therefore, it appears, that even in the true Reſins of Vegetables, there is ſuch a diverſity as ſhews them to be very different from one another. This Liquor too may be inſpiſſated at pleaſure by a very gentle Diſtillation, and then it has the appearance of an Oil.

USE.

THIS Operation then makes appear the true nature of Camphire as before explained. The Spirit drawn from it by Diſtillation, is vaſtly penetrating and volatile, is an excellent preſervative againſt a Mortification and Putrefaction, is drying, promotes Perſpiration, and with reſpect to the Blood and *Serum*, is a Styptic. The application of it to the bare Nerves, however, one would imagine ſhould not be ſo proper, on account of its very drying quality.

PROCESS LXVII.

Quinteſſences, as they are call'd by the Chemiſts, by the help of the Proceſſes 23 *to* 30, *and* 48, 49.

APPARATUS.

1. TAKE a choice diſtill'd, aromatic, eſſential Oil, put it into a dry, clean glaſs Veſſel, and pour upon it 12 times as much of the very pureſt Alcohol, that which has been alcaliſated in particular, and then diſtill'd, that it may not contain the very leaſt quantity of Water. Shake them then together, and the Oil will diſappear, and will be ſo intimately united with the Alcohol, as to form one very limpid, clear, homogeneous Liquid. But you muſt take care too, that there is no Water in the Oil, for otherwiſe the Experiment will not ſucceed.

2. Alcohol, therefore, and eſſential Oils, are of ſuch a nature with regard to one another, that they will bear to be intimately mixed and united together, provided you can keep them perfectly free from Water, for even the Moiſture of the Glaſs, or ones Breath, will prevent their union. And when they are moſt accurately combined together, upon pouring Water upon them, the Mixture grows white, and opake, and the Water attracts the Alcohol to it, and ſeparates it from the Oil.

5. If Alcohol, ſaturated with an eſſential Oil, is diſtill'd perfectly cloſe with a gentle Fire, and is cohobated ſome number of times, the Oil becomes gradually ſo volatile, that great part of it will riſe with the Alcohol. By this means, therefore, theſe Oils are rendered more ſubtil and active, and are, like Spirits, advanc'd to the greateſt penetrability, and yet with a retention of their proper Vertues.

4. But again, if you diſtill this Mixture of Oil and Alcohol with a Heat of only 90 degrees, then the Alcohol will riſe from the Oil, carrying up with it nothing but the *Spiritus Rector*, whilſt the oily part will remain at the bottom. And if by very gentle Cohobations, you thus artfully ſeparate the thin part from the thicker, you will at laſt have an Alcohol ſo impregnated with theſe Spirits, that it will almoſt appear pure ſimple Spirits; but the thicker part of the Oil at the ſame time will be exhauſted, and become quite effete.

USE.

1. IT was the Opinion of the ancient Chemiſts, that Fire, Air, Water, and Earth, concur to the formation of ſenſible Bodies; but beſides theſe, they ſuppoſed farther, that there is another fifth Principle, which being added to the Compound ariſing from the combination of the former, gives every Body that proper and peculiar diſpoſition, on which principally depends the Colour, Smell, Taſte, and Vertue, of ſuch a particular Body. This, therefore, being ſuperadded to the other four Eſſences, they called the (*Quinta Eſſentia*) Quinteſſence of Bodies. This they imagined to be contained in its Body, in an exceeding ſmall quantity, but at the ſame time to be vaſtly efficacious, and when it is

ſeparated from it, to be fit to animate the Spirits of ſome other Body into which it is infuſed; upon which head *Iſaac Hollandus* and *Paracelſus* deſerve to be conſulted. There is ſcarce any Method, now, that is properer for the preparation of this Quinteſſence, than that which we have mentioned: Certainly one drop of ſuch a preparation from Oil of Cinnamon, diluted in a glaſs of Canary, in the moſt grateful manner inſtantly revives the ſinking Spirits. Hence in a *deliquium*, languor, ſuffocation, or penury of the animal Spirits, of all Remedies it is the moſt excellent. Nor indeed, do we know that more efficacious Vertues can be extracted from Vegetables by the Chemical Art.

2. If a drop of ſuch a Mixture of Alcohol and Oil is let fall into Water, it ſoon grows white, and by this means furniſhes us with a Method of diſcovering ſuch an adulteration of theſe Oils with Alcohol.

3. Hence we underſtand the Power of Alcohol, which acts particularly upon the Spirits, and Oils of Vegetables, by diſſolving them, and then intimately uniting them with itſelf, and thus forming a Compound, which ſeems to act afterwards with an equable Vertue. And tho' theſe Oils are found to exiſt in Vegetables in various forms, this ſignifies nothing with regard to their union with Alcohol, provided they are quite free from Water. But in this oily Part, under all its different appearances, the Spirits abovementioned are always found be entangled and retained.

4. Betwixt all theſe Preparations and Fire, now, there is obſerved a great Affinity; for if theſe Quinteſſences are taken internally, they heat the Body, and being uſed imprudently in a large quantity, quite burn it up; and if they are applied to the Body externally, they produce all the effects of a pretty acute Inflammation, and carry this on even to a Gangrene.

PROCESS LXVIII.

Dry Quinteſſences prepared from Proceſs 65, 67, with Sugar.

APPARATUS.

1. TAKE ſome Alcohol combined with an aromatic Oil, pour it upon ten times as much Loaf-ſugar, very dry, and finely powdered, and rub them for a good while in a glaſs Mortar till they are accurately mixed together. Put this Compound into a China Cup, and place it in a clean glaſs Cucurbit that has a moderate Heat all round it, that thus the Spirit that keeps the Sugar moiſt, may very gently exhale, which, by putting on a head, may be collected under the Title of a Liquid Quinteſſence. In the China Cup will remain the dry Sugar impregnated with the Quinteſſence deſired. This, then, muſt be immediately put into a Vial, and be ſtopt very cloſe, and is then properly a dry Quinteſſence. If you take 1 drachm of the fineſt wheaten Flower, and 5 drachms of Loaf-ſugar, both very dry, and rub them together in a glaſs Mortar, and pour upon them 1 drachm of a Liquid Quinteſſence, and then proceed as before, you will by this means too have a very elegant Quinteſſence.

2. If you take 1 drachm of the Liquid Quinteſſence of Proceſs 67, $\frac{1}{2}$ a drachm of the Eſſential Extract of 65, and of Loaf-ſugar, and Flower, each 3

3 drachms, and treat them in the manner deſcribed, you will have the ſame kind of Medicine almoſt, but a compound one.

3. As any of theſe eſſential Oils now may be diluted in Alcohol, and tho' many of them are mixed with it will form but one homogeneous Liquor, which may be applied to the ſame uſes, hence it appears, that an infinite variety of noble Compounds may by this means be produc'd, according to the pleaſure of the Operator, each of which will vie with the reſt in point of Excellence.

USE.

HENCE we ſee how greatly the Chemical Art aſſiſts the preparation of Medicines, by reducing them to a very ſmall compaſs, and yet with a wonderful Efficacy. For if a ſcruple of ſuch a dry Quinteſſence is mixed with an ounce of Canary, it makes a Draught, which contains all the Vertues that we can expect from Aromatics. When the Phyſician, therefore, judges that ſuch a kind of Remedy is neceſſary, he may readily borrow it from the Chemical Art. And theſe Preparations have this great advantage, that they will keep good for a long while, and one may without any trouble carry them with one in all one's travels and voyages, and ſo have them ready for uſe, when one can't have recourſe to an Apothecary's Shop, nor ha'n't time for any longer Preparation. And in this particular again, the Excellence of the Chemical Art appears very evident.

PROCESS LXIX.

A ſimple aromatic Spirit from Lavender Flowers.

APPARATUS.

1. TAKE of freſh Flowers of Lavender, juſt in their maturity, and gather'd on a hot fine day in the afternoon, 6 ounces, of common Spirit of Wine 12 pints, and diſtill with a Worm according to Art, till there begins to come off a white watery Liquor. In the firſt place then, you will have a limpid, pellucid Spirit, which will be impregnated with the proper Smell, and Taſte of the Lavender, and muſt be kept by itſelf. To this there will next ſucceed a turbid, whitiſh Liquor, of which you may collect and keep one Pint; and then at the bottom of the Still there will be left a browniſh black Liquor, together with the Flowers, which will not retain much of their proper ſenſible Vertues. The firſt of theſe Liquors is the Spirit of Lavender, the ſecond the Water.

2. Take of the ſame Flowers of Lavender 3 ounces, pour upon them the Spirit and Water of the former Diſtillation, and diſtill as before, and you will have a pure, pellucid Spirit, as in the former caſe, which keep by itſelf under the Title of a double Spirit of Lavender: But here draw off none of the white Water, for fear of an *Empyreuma.* To the *Reſiduum*, however, you may add 2 pints of freſh Water, and then diſtill 1, which will ſerve again for future Diſtillations.

3. If in the ſame manner you diſtill 2 ounces more of the freſh Flowers with the preceding double Spirit, and the Water drawn off in the way directed, then the Liquor will ſtill be more ſtrongly impregnated with the proper Spirit of the Lavender: The Water is added, that the Flowers may not grow dry, and be burnt, when the laſt part of the Spirit comes to riſe, for this being then left behind prevents it. If you proceed to repeat this Diſtillation a ſufficient number of times, you will at laſt have a moſt excellent Spirit. The ſame Operation, tho' more ſlowly, may be perform'd in a glaſs Cucurbit, or even in a glaſs Retort, and that with but little trouble, and very clean. In this manner I have advanc'd theſe Spirits to the greateſt Perfection. This then is the general Method of preparing theſe Spirits from aromatic, ſweet-ſcented Flowers. The principal that are made uſe of for this purpoſe, are the Flowers of the garden Clove, Saffron, Jeſſamy, Lavender, white Lilies, Lilies of the Valley, *Marum Syriacum*, Oranges, Citrons, Lemons, Roſes, Roſemary, *French* Lavender, and the Lime, all which require the ſame management. But among all theſe, that famous Spirit drawn from Roſemary Flowers, called Hungary Water, has the preference, and is every where greatly in uſe.

USE.

1. WE eaſily perceive now, that the eſſential Oil of the Flowers will be carried up in this Diſtillation, as in Proceſs 25, whilſt at the ſame time the pureſt part of the Spirit, coming near to Alcohol, will riſe with this firſt Oil, according to Proceſs 48. This Spirit too, like Alcohol, will diſſolve the Spirit of the Lavender, and this aſcending Oil, by Proceſs 67: But as ſoon as ever the Alcohol is drawn off, and the Water begins to riſe, then the Oil which aſcends along with it, makes the Water white, according to the Proceſſes 23 to 29. Hence then we ſufficiently underſtand the Method of preparing theſe Spirits, and exalting them at the pleaſure of the Operator.

2. Hence, likewiſe, we eaſily conceive of the Vertues of theſe Spirits, which are almoſt the very ſame with thoſe of the Liquid Quinteſſences, of Proceſs 67, ſo that upon this head we need ſay nothing. That this is the caſe is evident; for if theſe Spirits are well prepared, they grow milky upon being mix'd with Water.

PROCESS LXX.

A ſimple aromatic Spirit from the dried Leaves of Mint.

APPARATUS.

TAKE ſome freſh Leaves of criſp Mint, a little dried in the ſhade, rub them gently betwixt your Hands, put them into a Still, and pour upon them 20 times their weight of common Spirit of Wine, and then diſtill with a Worm till you have drawn off one half, which keep under the Title of Spirit of Mint. Put the whole that remains in the Still into a Cloth, and preſs out all the Juice. Then take half the quantity of freſh Leaves you made uſe of before, pour upon them the former Spirit and all the Liquor expreſ'd from the *Reſiduum*, and diſtill again to one half, and repeat this to the third time, and you will then have a Spirit, which you may call a Tripple Spirit.

USE.

IN the ſame manner may theſe Spirits be drawn from any Herbs of the like nature; and the Operation may be perform'd leiſurely in our little wooden Furnace. This Spirit of Mint is an incomparable Medicine in Vomitings where there is no Inflammation, in windy Diſorders of the Stomach and Inteſtines, and in Gripings ariſing from an acid, mucous, cold, watery Cauſe; for in theſe caſes, half an ounce gives immediate relief.

PROCESS LXXI.

A ſimple aromatic Spirit from green Leaves of Roſemary.

APPARATUS.

BUT the Leaves too of thoſe rich aromatic Vegetables, which when they are green, and in their full ſtrength, are not very juicy, will, by the ſame management, yield excellent Spirits; of which I will here give you an inſtance in Roſemary. I take then ſuch a quantity of the tender Leaves of Roſemary cropt from the tops of the Branches, as is ſufficient to fill the Belly of this glaſs Retort half full, and pour upon them as much Spirit of Wine as will fill it two-thirds. I then place it in our little wooden Furnace, and applying a large Receiver, diſtill ſo long as the ſtreaks in the Receiver diſcover that the Spirits continue to come over, the ceaſing of which indicates that you muſt proceed no farther. I then preſs out the Liquor from the *Reſiduum* that is left at the bottom, and cleaning the Retort, put ſome freſh Leaves in, and pour upon them the preceding Spirit and expreſſed Liquor, and diſtill again as before; and this I repeat to the third time, by which means, I have, as you may here examine, an excellent Spirit. With theſe ſame inſtruments, I formerly repeated this Operation a great number of times, always cohobating the Spirit that came off upon freſh Roſemary, in hopes of having at leaſt an exceeding pure Spirit of Roſemary; but I was baulk'd in my Expectations, for in ſuch a number of Diſtillations, it had contracted a diſagreeable Smell, like that of Wax freſh collected, and by that means was ſpoiled.

USE.

HENCE, then, it appears, that in ſome Vegetables, the very ſame Spirit reſides in the Flowers, Leaves, and tender Branches, and may be extracted from them; for this Spirit cannot be diſtinguiſhed from that prepared from the Flowers of Roſemary, by Proceſs 49, and has the very ſame Vertues. The Leaves of Lavender, Thyme, Sage, wild Thyme, *French* Lavender, Rue, Origany, Calamint, and all the hot aromatic Plants, are fit for this purpoſe. From Barks, Woods, Roots, and Seeds too, both dry and green, may be prepared in the ſame manner moſt excellent aromatic Spirits; witneſs that noble Spirit drawn from yellow Saunders.

PROCESS LXXII.

A compound aromatic Spirit.

APPARATUS.

1. FROM what has been hitherto laid down, it ſufficiently appears, that the *Spiritus Rector* of Vegetables is a fine Particle, endued with a ſingular Vertue, frequently of incredible efficacy; that this is entangled and held down by the eſſential Oil; that theſe Oils of different Vegetables may, together with their proper Spirits, be mixed into one homogeneous Liquid, in which all the Spirits will be united and retained; and laſtly, that this Mixture may be diſſolved by Alcohol of Wine into an aromatic, oily, compound Spirit, of moſt excellent medicinal Vertues, in which the different Spirits will be combined, and made to conſpire in the ſame Operation. It is evident, therefore, that there can be no particular rule laid down for theſe Preparations, only take care that the Simples you chuſe for this purpoſe, have ſome agreement in Smell and Taſte, and are ſuch whoſe united Vertues will make amends for the trouble of compounding them. As an Example of ſuch a compoſition, you may take the following Proceſs, which I formerly made frequent uſe of, particularly in the Preparation of a *Sal Volatile Oleoſum.* Take of the choiceſt, freſh, thin, aromatic Peel of *Sevil* and *China* Oranges, Citrons, and Lemons, and Bark of Cinnamon, of each 4 Ounces; of the Flowers of Oranges, Citrons, Lemons, Lavender, Red Roſes, and Roſemary, of each 2 ounces; of the Roots of Angelica, and *Florentine* Orris, of each 1 ounce; of aromatic Cloves, Mace, and Nutmegs, of each 2 drachms; of rectified Spirit of Wine 15 pints; mix and diſtill with a Worm, according to Art, as long as a limpid Spirit comes off, which keep by itſelf. Proceed then till you have drawn off 2 or 3 pints more of a white Water, which keep under the Title of a compound, ſpirituous, aromatic Water.

2. If you have a mind to repeat the ſame Operation, take all the abovemention'd Simples, and the Spirit of Wine, but add to them likewiſe all the former white Water, and by this means you will have ſtill a finer Spirit. And by ſaving the Water every time in this manner, and making uſe of it again, I conſtantly procured a more excellent Spirit, as is very eaſy to conceive of, for it was at laſt almoſt like a pure Oil.

3. If the Spirit prepared in the manner deſcrib'd, is drawn off again from a few freſh Simples with a Cucurbit, and you tie a little Ambergreaſe finely powder'd in a Rag, and ſuſpend it in the Alembic, the Spirit as it riſes will ſubtly extract its Fragrance, and be impregnated with it.

4. If a Perſon has a mind to prepare the ſame Spirit in our wooden Furnace with a leſs *Apparatus*, he muſt diſtill a leſs quantity at a time, *viz.* in proportion to his Veſſels. And then I generally chuſe to make uſe of a Retort, and proceed very gently.

USE.

WHoever conſiders thoſe things which we have explained in this and the 69th, 70th, and 71ſt Proceſſes, will eaſily comprehend what is the proper uſe of the Spirits thus prepared, and how far their power is extended: For they never can by any Art whatever be converted into our Spirits, but will always, let the Chemiſts ſay what they pleaſe to the contrary, remain of a nature quite different from theirs. Hence they can never truly ſupply a proper defect of our Spirits, and for this reaſon it is no ways true, that theſe being infuſed into the Body can perform the office of that power which generates the Spirits, when it is fairly impair'd by old age. In the mean time, however, by their wonderful Activity, their fine Fragrance, grateful Taſte, and inexplicable Suitableneſs to our Spirits, they are greatly diſpoſed to exhilarate them, though the effect laſts but a ſhort time. The too frequent actions of them however upon our Spirits overcomes, and diſſipates 'em. And hence, when we once come to be uſed to 'em, though they quicken a little for the preſent, they afterwards leave us more languid, and make the application of ſuch a *Stimulus* more frequently neceſſary. Thus then I think I have ſufficiently explained the uſe of theſe Spirits, both from Chemiſtry and Phyſick.

PROCESS LXXIII.

Soap from expreſs'd Oils, and the fixed Alcali of Proceſs 13.

APPARATUS.

1. IN this Flaſk I have ſome expreſs'd Oil of Olives, and in this glaſs Veſſel the ſame weight of Oil of Tartar. I pour the Oil now very gently upon the *Lixivium* of the Salt, and you perceive, that the Oil ſwims at top, and both Liquors continue clear. I ſhake them therefore together, and hereupon the Mixture becomes white, opake, thick, and ſomewhat tenacious, and if it is ſet by, continues thus equably mixed for ſome time: At laſt however, by only ſtanding quiet, they ſpontaneouſly ſeparate from one another. Hence therefore it appears, that expreſs'd Oils, which always abound with an Acid, are of ſuch a nature, that they'll bear to be mix'd with an Alcali, even though this is diluted with Water; though at the ſame time it muſt be obſerved, that this Union is not ſo ſtrong, but that the Compound will be eaſily reſolv'd again into its conſtituent parts. It is probable now, that the Acid here performs the office of a *Vinculum* to keep theſe different Bodies together; for Oils, that are depriv'd of their Acid, are combin'd with Alcali's with more difficulty.

2. If the Mixture produc'd in this manner is gently boil'd with a ſlow Fire, that the Water may gradually exhale, it will be reduced into a conſiſtent Maſs, of a white Colour, a nauſeous oily Smell, and an acrid, alcaline, diſagreeable, pinguious Taſte, and eaſily diſſolves in the Air. But if, during the boiling, a proper proportion of diſſolved Alcali, or Oil is added and mixed with it in ſuch a manner, that the Compound will intirely diſſolve in Water without any appearance of Oil, and yet at the ſame time has nothing of an alcalious Taſte, and will keep its conſiſtence in the Air, it is then called a perfect Soap.

3. It has been found now by repeated Experiments, that the more acrid the Alcali is, the more perfect will be the union of that and the Oil into a true Soap. As it appeared therefore, according to Proceſs 13, that the penetrating and igneous power of an Alcali may be wonderfully advanced by Quick-Lime, hence this fiery Alcali prepar'd with Quick-Lime came to be uſed inſtead of a ſimple one. And as it was obſerved likewiſe, that this combination was render'd ſtill more perfect by long boiling, and of conſequence, that a greater quantity of Water was neceſſary for this purpoſe, hence they added this more plentifully. And laſtly, they diſcovered by practice, that a certain proportion betwixt the Oil and the Alcali was here requiſite likewiſe. The following method, therefore, was found at laſt almoſt certainly to ſucceed.

4. In the firſt place, they take a fix'd, igneous, alcaline Salt, well prepared with Quick-Lime, according to Proceſs 13. This they diſſolve in clean hot Water, till the Lye will bear a new-laid Egg; and this the Workmen call the Maſter-Lye. To a part of this they then farther add ſuch a quantity of Water, that in this ſecond Lye the Egg will juſt ſink to the bottom, and this they call the weaker, or under Lye. With an equal quantity of freſh Oil of Olives, they then mix this weaker Lye, as accurately as poſſible, ſo that the Mixture ſhall be exceeding white, which they proceed to boil with a gentle Fire, keeping it frequently ſtirring, till by the diſſipation of the Water, in particular, theſe Bodies begin to be thoroughly incorporated with one another. When they obſerve this to be the caſe, they then add three times as much of the Maſter-Lye as they us'd of Oil, and mixing them together, continue to boil them, till a little of the Compoſition dropp'd on a cold Stone will acquire a proper ſolid conſiſtence. And if then a bit of this cold Maſs will perfectly diſſolve in Water, without diſcovering any Oil, it is a proof that the Oil is ſufficiently combin'd with the Alcali; but if ſome Oil does appear in ſuch a ſolution, then a ſmall portion more of the Maſter-Lye muſt be poured in, and you muſt proceed to boil, till the Matter will be diſſolved intirely. You muſt then taſte the Soap, and if you find it acrid, and alcaline, it is a ſign that the Alcali is predominant, for which reaſon you muſt then add a little more Oil, and boil as before, till at laſt you have by this means obtained a Maſs, which in the cold will be hard enough to cut, will diſſolve perfectly in Water, has not an acrid, alcaline Taſte, nor will run *per Deliquium.* This then is properly true Soap.

5. Inſtead of Oil of Olives, you may make uſe of the Fat of Beaſts or Fiſh, of which we have an inſtance particularly in the black Soap prepared with the Blubber of the Whale. The more pure, however, the Alcali is, and the neater the Oil, without any diſagreeable Smell and Taſte, the more beautiful will the Soap be, and the fitter, eſpecially, for medicinal uſes.

USE.

HERE then we ſee the intimate union of a native Oil with a fixed Alcali, effected by the help of Water and Fire, whence there ariſes one homogeneous Maſs, which is perfectly diſſoluble in Water. So that hence it appears, that the Oil muſt have loſt its priſtin pinguious nature, and put on a new one, which is not ſo repugnant to Water; and that this is brought about by means of an acrid, fix'd Alcali. For this reaſon therefore, when the Humours of the human

man Body abound with too great a quantity of Oil, the Salts are generally deficient, and hence in ſuch a caſe fixed alcaline Salts prudently adminiſtred are not without their uſe. From what has been ſaid too we learn by what means the Acrimony of Alcali's may be quite obtunded, ſo that they ſhall be intirely deprived of their corroding quality, and rendered mild, *viz.* by mixing with 'em a ſufficient quantity of Oils. In diſorders, therefore, where ſuch an acrid, ſaline Matter is found to be predominant, freſh expreſs'd Oils, taken in a pretty large quantity will help to mitigate it. In very acute caſes, and one very bad ſort of Scurvy, this has been confirmed by happy ſucceſs. Nor are they without their uſe where there is a troubleſome Acrimony in any particular part, as when a Stone lodg'd either in the Kidneys, or Bladder, by abſorbing the Urine, and retaining it in its Pores, renders it acrid. In this compound Body of Soap now the tenacity of the Oil, which diſpoſed it to foul other Bodies, is deſtroyed, and at the ſame time the original deterſive power of the lixivious Salt remains, though without its former corroding quality. For if you diſſolve this in Water ſo as to make a pretty ſtrong *Lixivium* of it, it will then, if aſſiſted with a proper Heat, Motion, and Rubbing, diſſolve gummy, oily, reſinous, and inſpiſſated, pinguious Subſtances, and render them ſaponacious too, or miſcible with Water; and hence it reſolves, opens, deterges, and cleanſes. By this means it attenuates coagulated Juices, and renders them capable of paſſing on in their Veſſels, and hence often overcomes inveterate obſtructions, and reſtores debilitated parts to their proper uſe. In foul concretions too from an Earth and an Oil, it proves of excellent ſervice. And laſtly, it prevents the coagulation of Chyle or Milk, by an Acid; nay, when they are actually curdled by it, it will reſolve them again. Hence therefore it appears, that in any of theſe caſes it proves almoſt a univerſal aperient, attenuant, reſolvent, and diſſolvent in the human Body, if it is taken when the Stomach is empty, well diluted, to a conſiderable quantity, and divided into ſuitable Doſes, and is aſſiſted by proper exerciſe. Externally applied too in ſinuous, fiſtulous Ulcers, it has a very good effect. If you have a mind, now, to hide the diſagreeable appearance of the Soap, you may eaſily do it, by giving it a Colour with Saffron, Turmeric, or Cochineal. And if it is ſtill offenſive to Perſons of a more tender make, on account of the unpleaſant Smell of the boil'd Oil, you may mend that by the addition of a little Balſam of *Peru.* In Diſeaſes, however, where Life is in danger, from a putrid, broken, and tabid diſpoſition of the Fluids, it does a vaſt deal of miſchief, of which there have been many inſtances in the Plague, and putrid Small-Pox, as we have faithfully related to us by the honeſt *Diemerbroeck.* Many more things might be ſaid of this noble Compoſition, but theſe may be eaſily deduced from what has been obſerved already, both for the uſe of the Chemiſt and Phyſician. I only add therefore, and ſo conclude, that Soap is capable of effecting that which neither Water nor Oil can do ſeparately, and does thoſe things ſafely, which ſimple Alcali's cannot, without danger, and which other Salts cannot at all.

PROCESS LXXIV.

Soap from a diſtill'd Oil, and the fix'd Alcali of Proceſs 12.

APPARATUS.

1. THE Chemiſts being convinced by Experiments of the Vertues of diſtill'd Oils, were concerned, that from their natural diſpoſition they cou'd not be readily mixed with the Humours of the human Body. As they ſaw, therefore, that expreſs'd Oils might with good ſucceſs be combined with a fixed Alcali, they attempted the ſame thing with diſtill'd; but to their Mortification they found, that by being boiled the Oils were enervated, and even then wou'd not unite with the alcaline Salt. They made a great many other Experiments therefore, in order to bring theſe Bodies into a laſting union, but commonly in vain. Being incited however by the hint and promiſes of *Van Helmont*, they at laſt ſeem to have diſcovered a method by which this combination might be effected. Many tedious trials upon this head I formerly went through myſelf, and at laſt the thing ſucceeded in the way which I'll candidly ſhew you. The great ſecret lies in this, that the acrid Alcali be exceeding pure, and dry, and the Oil perfectly free from Water. If this is taken care of, every thing elſe will be brought about ſucceſsfully enough by the Atmoſphere; but if the leaſt quantity of Water, by any means inſinuates itſelf among them, the union will be prevented, and your labour loſt.

2. Take ſome very pure, acrid, fixed, alcaline Salt, prepar'd according to the fifth Paragraph of Proceſs 12, and whilſt it is ſtill juſt red hot from the Fire, in a clean iron Mortar, and with an iron Peſtil, reduce it to a Powder, the finer the better, and then immediately throw it into a very pure, dry, thin Glaſs, ſuch a one as is made uſe of in the examination of Urine, commonly called a Urinal, which muſt be firſt made very hot, and diſpoſed in a very hot dry place; and this ſhou'd be done on a fine dry day. The very moment then that the hot Salt is at the bottom of the Urinal, drop into it ſome of the pureſt diſtill'd æthereal Oil of Turpentine, made very hot likewiſe, in ſuch a manner that the Drops ſhall ſucceed one another very faſt, and ſhall fall into the middle of the Salt. By this means then the Oil, as it falls in, will, with a great Fume and Noiſe, be attracted into the dry Salt, even to its inmoſt parts, and ſo diſperſe itſelf through the whole ſaline Maſs. Proceed in this manner as quick as poſſible, till the Salt has abſorbed ſuch a quantity of Oil, that what is dropt in afterwards continues to ſwim at top, and thus perfectly ſecures the ſurface of the Salt from any contact with the Air, which is always full of moiſture. When you perceive this to be the caſe, ſet the Urinal by in a place under ground, cover'd only with a Paper, and the Oil will in a ſhort time diſappear, being united with the alcaline Salt. Pour upon it then a little more of the ſame hot Oil, and with a Stick mix it well with the former Maſs. Set it by again in the ſame manner, and thus proceed till there is almoſt three times as much Oil as Salt in the Compoſition, and you will then have an equable ſaponacious Maſs that is wonderful penetrating. And here the more it is ſtirr'd and rubb'd together, the more perfect and expeditious will be the union; for which reaſon,

nothing in this caſe is more effectual than putting it into a ſtrong Bottle, and fixing it in a Poſt-Chaiſe that travels every Day, as was long ago obſerved by the famous *Grew* and *Bohn.* And for my own part, I can aſſure you, that when I have had a careful regard to all the circumſtances juſt mention'd, the event has always prov'd ſucceſsful, though it never did ſo when I have neglected the very leaſt. If a little of this Soap, then, will perfectly diſſolve in Water, without diſcovering any appearance of Oil, it is a proof, that your Operation is compleat.

3. If the Soap made in this manner is ſuffered to ſtand long in the Urinal, there gradually riſes upon the ſides of the Glaſs a white, cryſtalline Salt, of a Smell not diſagreeable, and a ſoft, penetrating, ſaline Taſte, but not an alcalious one. This is wonderfully ſubtil, and diſſolves eaſily, and furniſhes us with a medicated Soap of vaſt uſe. And the ſmall quantity that thus aſcends, I am apt to think, gave riſe to that aſſertion, perhaps, too free a one, that the fixed Salt of Tartar, by means of an Oil united with it, has been render'd volatile and prov'd a *Succedaneum* to the *Alcaheſt.* When I have expoſed, however, the Soap well prepar'd in this manner, to the Fire, I confeſs, I have not met with the promis'd volatile Salt.

USE.

FROM the Evidence of this Experiment, then, we learn, again, with what greedineſs a pure fix'd alcaline Salt attracts and unites with itſelf theſe Oils; and how this, from an alcaline, acrid, fiery nature, is ſoften'd to a mild, oily Salt. With regard to its Power of preventing and reſolving an acid, auſtere, or viſcid *Coagulum*, I treated ſufficiently in the preceding Proceſs, to which I refer you. Here, therefore, I ſhall only obſerve, that all the ſaponacious Vertues there recited are in this ſort of Soap more generous and active, and that this is always conſiderably heating. Thus then we ſee the diſpoſition of a diſtill'd Oil, and a fix'd alcaline Salt, with regard to one another, and the nature of the pound ariſing from the mixture of 'em together according to Art. The Salt generated in this manner, Dr. *George Starkey*, and his Followers, aſſerted to be volatile; but, as I obſerv'd before, I never found it ſo. This is the Soap which *Matthews*, a Quack at *London*, prepar'd under the name of the *Corrector Matthæi*, to which he added Hellebore, Liquorice-root, and Opium, and then digeſted 'em together, and form'd 'em into Polychreſtic Pills, which were diaphoretic, no longer emetic, or purging, but anodyne, though they often provok'd Vomiting the day following. A better preparation of theſe Pills Dr. *Starkey* ſubjoin'd to his *Pyrotechny*, extravagantly, according to the cuſtom of the Chemiſts, extolling their Vertues, and aſſerting, not very properly, that the whole Vertue of the Hellebore was retain'd, though its emetic Quality was deſtroy'd. But let this ſuffice concerning the preparation of this Soap. The excellent *Homberg* obſerves, that a ſtrong *Lixivium* of this, upon being mix'd with a ſharp Acid, is alter'd, and grows turbid, the Alcali being attracted into the Acid, and the Oil being by this means diſlodg'd, and ſo appearing again, *Hiſt. de l'Ac. Roy. des Sc.* 1709. If theſe Soaps, when they are pretty dry, are digeſted with the pureſt Alcohol, they are in ſome meaſure diſſolv'd into the *Elixir parvum Sapientum*, in which there is a Salt, Sulphur, and Spirit combin'd together.

PROCESS LXXV.

The Preparation of Tartariſated Tartar.

APPARATUS.

TAKE a pretty large quantity of white Tartar, very pure, and in large Lumps, reduce it to a very fine Powder, put it into ten times its weight of clean Water in a braſs Veſſel well tinn'd, and make it boil briskly, that the Tartar may be ſufficiently diſſolved; and let the Veſſel be plac'd upon an open Fire, that the Water may be kept conſtantly boiling. The Liquor then will have a very acid Taſte, be almoſt clear, and pretty pure. Into this boiling *Lixivium* of Tartar drop ſome Oil of Tartar *per Deliquium*, and keep up your Fire in ſuch a manner, that, even whilſt you are doing this, it ſhall continue boiling. Upon every Inſtillation then of this alcalious Liquid there will ariſe a very great Ebullition, cauſed by the Alcali's meeting with the Acid, as appears evidently from the Efferveſſence's ceaſing immediately, which muſt then be rais'd afreſh by dropping in ſome more of the Alcali. And as this is done whilſt the Liquor is kept boiling, there will be produc'd a great many large ſpherical Bubbles, which will burſt aſunder, and be immediately ſucceded by others. In theſe Bubbles, the Chemiſts, by the help of their Eyes and Imagination together, have diſcover'd, or at leaſt have thought they have diſcover'd, the proper figure of the Grapes. Proceed then patiently in this manner, till at laſt a Drop of the Alcali will excite no Efferveſcence in the boiling Liquor; and by this means the Acid of the Tartar will be ſaturated with ſuch a quantity of its proper Alcali, *viz.* one produc'd from burnt Tartar, that there will then be no appearance of an Acid, or an Alcali in the Mixture, but you will have a certain third ſort of new Salt. And here you muſt take great care to obſerve nicely this point of Saturation; for if you leave off too ſoon, the Salt will be acid; and if you proceed too far, it will be alcaline: About the end, therefore, you muſt be very careful.

2. Let the Mixture be run ſpeedily through a woollen Bag, till it at laſt becomes limpid, always obſerving to keep it boiling hot. The Liquor then will be of a browniſh black Colour, of a particular, bitteriſh, ſaline, ſaponacious, ſub-pinguious Taſte, and without any Smell. If you inſpiſſate it on the Fire till there appears a Pellicle on the Surface, and then let it ſtand quiet for a good while in a cool place, at the bottom and ſides it will depoſite ſome ſaline little Maſſes, which being collected together form a Tartar, which eaſily diſſolves in Water, even in the cold, though it was ſo difficult to be diſſolved before, nay, ſcarcely with the heat of boiling Water. This, therefore, may properly, and conveniently enough, be call'd Soluble Tartar.

USE.

TARTAR, in its hardneſs, approaches ſo near to the nature of Stone, that, being indiſſoluble by its own Wine, it forms a kind of Veſſel round it, through which it cannot penetrate, and is hence call'd, very properly, by the *Germans*, Wine-Stone. It contains in it an evident Acid, by vertue of which it generally acts beautifully in the firſt paſſages of the human Body. And, indeed, the Acidity of it is ſo great, that it cauſes a violent Efferveſſence with the Alcali that may be eaſily produc'd from it by Proceſs 55. When this Acidity, however, is counterballanc'd by a ſufficient quantity of an Alcali, the Tartar then becomes tractable, and diſſolves with eaſe, both the Acid and the Alcali being deſtroyed, and a new kind of Salt being produced from them. The Salt now, thus generated, is found to have excellent effects in the human Body. If it is diluted with Water, and drank faſting, by its efficacious diſſolving, deterſive, and gently purging Quality, it proves an admirable Medicine in many Diſeaſes, and thoſe pretty ſtubborn ones too. If it is applied externally to foul Ulcers, it cleanſes them, and diſpoſes them to heal more kindly. Whether this is the Medicine which *Paracelſus* boaſted of, by the help of which, he tells us, all freſh Wounds would unite in the ſpace of a few hours, without any ſuppuration, I won't pretend to determine: This he call'd *Samech*, which ſeems to be fram'd from a word in *High-Dutch*, which ſignifies to conglutinate, or glue together. Be this as it will, this I'll venture to aſſert, that the pure Liquor of this Salt diſſolv'd in Water, ought to be rank'd amongſt the choiceſt *Menſtruums* that the Chemical Art is maſter of. If any Perſon has a mind to be ſatisfied in this, let him boil Gum Lac, Myrrh, and the like, in this Liquor, and he'll be ſufficiently convinc'd, that it can ſcarely be prais'd enough. Hence it appears, that the viſcid Concretions, form'd in the firſt paſſages, may be reſolv'd by the uſe of this Medicine. Nay, and it is believ'd, that by the uſe of it, conſtantly continued, and gradually increas'd, even the tartareous Matter of the human *Calculus* in the bilious and urinary Paſſages may be diſſipated likewiſe. In nephritic, icterical, ſplenical, and hypochondriacal Diſorders it is of ſervice. By a proper attention, now, to this Proceſs, we learn, likewiſe, what good Effects may be expected from the Cream, Cryſtals, or Powder of common Tartar, in thoſe caſes, where the Bile, in particular, or the other Humours in the *Abdomen*, begin to grow putrid from a burning Fever, or any other cauſes, and acquire an alcaleſcent diſpoſition; for this will be mitigated by the native Acid of the Tartar, and will immediately be converted, in the Body, into a mild Salt, which will eaſily diſſolve, and open and remove obſtructions, without ſtimulating the Veſſels to too great a degree.

PROCESS LXXVI.

Regenerated Tartar.

APPARATUS.

UPON a very acrid, pure, dry, fix'd, alcaline Salt, contained in a large glaſs Veſſel, with a pretty narrow Neck, I pour pure, and pretty ſtrong diſtill'd Vinegar, till it almoſt covers the Salt, and there ſcarcely appears any ſenſible Efferveſcence, which certainly is ſurprizing, as one wou'd naturally expect that ſuch a very ſtrong Alcali ſhou'd cauſe an Ebullition with the Acid. It ſeems, therefore, as if this weak Acid wou'd not produce this Effect, in this caſe, on account of the Alcali's being too ſtrong for it. I ſhake them, now, well together, and for a good while, and by degrees an Efferveſcence begins to ariſe, which ceaſes, however, immediately. I pour on therefore more of the ſame diſtill'd Vinegar, and the Ebullition is now ſomewhat greater, and upon ſhaking the Veſſel becomes ſufficiently evident. And upon repeating this the third time, you now obſerve a moſt furious Efferveſcence, with a prodigious Froth and Noiſe, which increaſes in proportion to the ſhaking of the Veſſel. And this now continues ſo for a good while, the Acid of the laſt Vinegar that is pour'd on, always cauſing a ſtronger Efferveſcence, as you approach nearer to the Saturation of the Alcali, which is generally obtain'd, when about fourteen times the Quantity of ſtrong diſtill'd Vinegar has been pour'd upon a ſtrong Alcali. About the end of the Operation, therefore, the Mixture muſt be heated, and briſkly ſhook about for ſome time, that we may be ſure not to add more Acid than is juſt ſufficient to ſaturate the Alcali, which may be diſcover'd at laſt by cautiouſly adding but a little at a time, and ſhaking it about till the laſt Quantity, though aſſiſted by Heat and Motion, will cauſe no farther Efferveſcence. This being done, ſet it by in a warm place for the ſpace of twenty four hours, and then ſhake it about, and if it don't diſcover any Ebullition, drop in a little more Vinegar, and if upon ſhaking it then too no Efferveſcence is excited, you may be ſatisfied that you have obtained the true point of Saturation. In this Experiment now the violent Efferveſcence diffuſes an exceeding elaſtic Vapour, as you perceived by the *Halitus* that burſts out at the top, notwithſtanding the Belly of the Veſſel in which the Salt and Vinegar were ſhook together is ſo capacious; for as I ſtop'd the Mouth with my Thumb whilſt I was ſhaking them, upon ſuddenly removing it afterwards, and giving the confin'd Vapour a vent, you heard with what a noiſe it iſſued out. Nay, if you perſiſt to keep it perfectly ſtopt during the Efferveſcence, the Veſſel will be burſt aſunder. The Liquor then that is produc'd from the Acid of the Vinegar, and the fix'd Alcali by this Operation is pellucid, of a ſingular Smell, not an acid one, and of a Taſte that is neither acid, nor alcalious, but of a third ſaline ſort. And as for Acrimony, this Liquor is ſcarcely diſcover'd to have any, but it is of a mild, innocent nature, and yet has a moſt efficacious power of attenuating, reſolving and evacuating by the Inteſtines, the Kidneys, and the Skin; and hence, in chronical caſes, where there is a thick obſtructing Matter, it proves an excellent Medicine, taken at a convenient time, and in a proper Doſe.

2. If this limpid Liquor, depurated from its *Fæces*, is diſtill'd with a Cucurbit and Alembic, it yields a pure ſimple Water; and at the ſame time the *Reſiduum* in the Veſſel becomes of a light brown Colour, then more upon the black, and ſo on by ſucceſſive degrees, till it becomes quite black, pinguious, thick, and of a very ſubtil Taſte, even ſuch a one as diſcovers its ſaponacious, penetrating, diſſolving Power. Take then a little of this Liquor, and mix with it a little Vinegar, and if there ariſes any Efferveſcence, it is a ſign that the Alcali is ſtill predominant, and therefore by a proper admixture of diſtill'd Vinegar it muſt again be ſaturated. And as this very often happens in this manner, the point of Saturation muſt be carefully ſought for.

3. When you have obtained this, let the Liquor by ſtanding quiet be ſeparated from its *Fæces*, and then draw off all the Water with a gentle Fire, and there will remain at the bottom a ſaline Maſs, of a blackiſh red Colour, and of an exceeding penetrating, and perfectly ſingular, ſaponacious Taſte. This

now has attracted and retained all the Acid of the Vinegar made uſe of, and has expell'd all the Water that was in the Vinegar, and diluted its Acid. And by a very careful Examination of Monſ. *Homberg*'s it appear'd, that the Alcali was, by this attraction of the Acid into it, increaſed about $\frac{9}{20}$ths of its weight; and the Acid extracted from the Vinegar, was about $\frac{1}{37}$th of the whole, ſo that the other 36 parts were pure Water. *Hiſt. de l'Ac. Roy. des Sc.* Vol. I. This then is the preparation of the Salt, which the Artiſts call *Tartarus Tartariſatus.*

4. If this tedious, coſtly Salt is urg'd with a ſomewhat ſtronger Fire, it becomes volatile, flies off, and cheats the Operator. When it is carefully dried with a gentle Heat, and is then expoſed to the Cold, it appears as if it was form'd by application of fine *Lamellæ*, or Flakes, to one another, like the *Lapis Specularis*, or Talc. With Heat, however, it diſſolves into a pinguious Oil; and yet in the Cold it recovers again the ſame form as before. Hence this Salt has been called likewiſe *Terra Foliata.* This, *Zwelfer*, in his Defence againſt *Otho Tachenius*, charges him with boaſting of, as diſſolv'd Talc.

USE.

THERE is not any one Experiment in the Chemical Art, that makes more diſcoveries to us than this does. Here we obſerve a new, and intirely unexpected *Phænomenon* in an Alcali, and an Acid, with regard to their exciting an Effervеſcence. Here we ſee Colours produc'd from a Liquor as limpid as Water, and then chang'd through ſucceſſive degrees to a perfect Blackneſs. And here we diſcover a pinguious, inflammable Oil, regenerated from an Alcali calcin'd in the intenſeſt Fire, and a very thin, ſharp Spirit of Vinegar; for when this Salt is dry it will flame in the Fire, and if it is diſtill'd with the laſt degree of Heat, will yield a true Oil. Hence then we learn, that the Salts form'd by the mixture of Acids with Alcali's, do not conſiſt only of an Acid and Alcali that may be ſeparated from them again, but that there is by this means ſomewhat new actually produc'd, of which there was not the leaſt appearance before. By this Operation too we may farther inform ourſelves, what proportion of abſolute Acid there is in any given acid Liquor, to the quantity of Water it is diluted with; and what proportion of acid, with reſpect to the Alcali, is required to make the Saturation complete. And here, laſtly, we learn the true method of converting the moſt acrid, fiery, fix'd, alcaline Salt, into a mild, compound, oily, ſaponacious, volatile one. This Salt, now, rightly prepar'd in the manner deſcrib'd, is one of the moſt excellent *Menſtruums* we are acquainted with, and being mix'd and digeſted with its proper Objects, diſſolves them into a uniform Maſs, which is very penetrating, and richly endued with their particular Vertues. In the human Body it is the moſt noble reſolvent yet known, and has this admirable quality, that both in hot and cold caſes it is uſed with ſucceſs, and indeed is ſuited to almoſt every Patient. All theſe things, then, being maturely conſider'd, I have been frequently in doubt whether this was not the *Sal volatilis Tartari* of *Van Helmont*, to which he gave ſuch prodigious encomiums, as to make it even a kind of *Succedaneum* to the *Alcaheſt*; eſpecially as it runs in the Fire like Wax. Certainly it ought to be look'd upon as the *Acetum Radicatum* of the ancient Chemiſts, as here the Vinegar returns back, and becomes united with its proper *Matrix*, the calcin'd

Tartar. If a Perſon however is too curious in diſſolving, depurating, filtering, inſpiſſating, and calcining this Salt, in order to make it white, he'll find, that it will by this means be diſſipated into the Air, and loſt, ſo that hence he will learn its Volatility, indeed, but will otherwiſe loſe his labour. And this I give the more particular caution of, becauſe the Author of this Preparation, the famous *Daniel Sennertus*, too much commends great diligence in the Affair, which, when it is applied to things but of little conſequence, makes the Operator's Pocket ſuffer for it.

PROCESS LXXVII.

A Tincture of Tartariſated Tartar.

APPARATUS.

TAKE ſome tartariſated Tartar, well prepar'd according to Proceſs 75, dried, and reduc'd to a fine Powder, put it into a tall Bolthead, and pour upon it as much of the pureſt Alcohol of Wine as will cover it to the height of four inches. With a Paper only ſtop the Mouth of the Glaſs, place it in our wooden Furnace, and with a very gentle Fire make the Alcohol boil for the ſpace of a night and a day; and then the Liquor that ſwims at top will be of a golden Colour, and have an aromatic Smell, and a penetrating warm Taſte. If you repeat this in the ſame manner with freſh Alcohol, there will at laſt be a white Salt left at the bottom. Let the Tinctures then be inſpiſſated with a moderate Heat, till there is but one tenth part remaining.

USE.

THIS Operation ſerves to diſcover to us that part of this Salt, that may be diſſolv'd by Alcohol. The Tincture thus prepar'd is aromatic, heating, cleanſes Ulcers, and conſolidates Wounds. The remaining Salt too, being purer, and more ſimple than it was before, teaches us, that by extracting a Tincture from them by Alcohol, even Salts themſelves may be render'd whiter.

PROCESS LXXVIII.

A Solution of regenerated Tartar by Alcohol.

APPARATUS.

UPON very dry regenerated Tartar, prepar'd as nicely as poſſible without deſtroying its Vertues, and diſpos'd in a tall Bolthead, pour ſix times its weight of the choiceſt Alcohol, and boil them very cautiouſly with a gentle Fire in our wooden Furnace. By this means they will become united together into one equable Compound, and there will be ſome *Fæces* depoſited at the bottom. Let the Veſſel ſtand quiet till the Liquor is well ſettled, and then gently pour off the clear Tincture from the *Fæces*, and if there is then any thing ſaline ſtill remaining, it may be diſſolv'd in the ſame manner with freſh Alcohol. Let theſe Liquors be put together, and with a very gentle Fire be inſpiſſitated to one half, and you will then have a Tincture of this Salt.

USE.

IN this Operation you have a vegetable Alcali, an oily vegetable Acid, and an oily vegetable Spirit compounded together. Hence you poſſeſs here the moſt active Principles of Vegetables, freed from their inert Earth, and at the ſame time not dangerous on account of their Acrimony. This Compoſition ſeems to be the *Elixir parvum Sapientum*, which the antient Chemiſts ſo much recommended for preſerving and reſtoring of Health. And certainly it reſolves almoſt all Obſtructions, inſinuates itſelf through all the Veſſels of the Body, and by a gentle *Stimulus* makes the animal powers to throw off the morbific Matter by Sweat. In the Chemical Art it proves a moſt excellent *Menſtruum*, reſolving Bodies into their minuteſt active parts, and thus diſpoſing them to penetrate, with their full ſeminal Power, into the inmoſt parts of the Body, and there to overcome the moſt ſtubborn reſiſtance. In external Diſorders too, as Ulcers, Wounds, and Tumors it is not uſed with leſs ſucceſs. Nor is this valuable Medicine ſo coſtly, that the Poor may not ſhare in it, for the regenerated Tartar may be readily prepar'd, by mixing Pot-aſhes with fifteen times their quantity of the ſharpeſt Vinegar, and then filtering and inſpiſſating, and then it will coſt but little Money or Labour, and yet will be very fit for uſe. This was known to the ancient *Romans*. *Plin.* XXIII. *in Proœmio. The Aſhes of Vine-twigs ſprinkled with Vinegar are drank for diſorders of the Spleen.*

PROCESS LXXIX.

Dr. Harvey's *Tincture of Salt of Tartar.*

APPARATUS.

I TAKE the very black alcaline Salt, that remains in the Retort, after the volatile part has been forc'd out by the ſtrongeſt Sand Heat in the Diſtillation of Tartar, according to Proceſs 55. Upon this, briskly reduc'd to Powder in a hot iron Mortar, and with a hot Peſtil, and then put into a tall Bolthead, I pour as much of the beſt common Spirit of Wine as will cover it to the height of four inches. I then place the Veſſel in our wooden Furnace, and with a gentle Fire boil the Mixture for the ſpace of twenty Hours. By this means I have a black thin Liquor, of a bitter, aromatic, lixivious Taſte, which I pour off clear, and keep in a cloſe Veſſel where it will continue good for a long time. This is Dr. *Harvey*'s Tincture of Salt of Tartar.

USE.

COMMON Spirit of Wine, conſiſting of Water, an Acid, and Alcohol united together, by being boil'd with this Alcali of Tartar which ſtill continues oily, makes a *Lixivium* that is mild and ſafe, as it is here render'd leſs acrid by the Acid, the Oil, and the Alcohol, whence ariſes a kind Medicine, and *Menſtruum*, of conſiderable Vertues. This being chemically boil'd, and digeſted with Vegetables is very efficacious in diſſolving them. In Surgery it is an excellent remedy for cleanſing, deterging, drying, and conſolidating moiſt, purulent, putrid, ſanious, virulent Ulcers, as well fiſtulous, as ſinuous: In fungous Excreſcences too it is uſed to eat them down with good ſucceſs, eſpecially if it is mixed according to art, with a ſmall quantity of Oil. Taken internally likewiſe, it has admirable effects, in thoſe Diſeaſes, where an acid, rough, watery, mucous, pituitous or earthy Matter abounds, as alſo in Coagulations, provided there is no putrid diſſolution of the Humours. Hence it is recommended in ſtubborn obſtructions of the Bowels, in watery defluxions, a *Leucophlegmatia*, Chloroſis, Jaundice, and cold Gout. It acts pretty ſtrongly by Urine, Sweat, and ſometimes by Stool; and may be given ſafe enough in a pretty large Doſe. If two or three drachms of this Tincture, ſoften'd with an Ounce of the Syrup of the five opening Roots, and then diluted with diſtill'd Fennel-water, are drank faſting for three or four Mornings, they often perform more than can be effected by other Medicines. Hence therefore the famous Dr. *Harvey* very juſtly extolls the Vertues of this Medicine. Nor were the ancient Phyſicians unacquainted with ſuch kind of Preparations for the ſame uſes, as you will be convinced by conſulting *Dioſcorides* I. 186.

PROCESS LXXX.

Van Helmont's *Tincture of Salt of Tartar.*

APPARATUS.

TAKE the black Salt of Tartar, which remains at the bottom of the Retort, in the Diſtillation of Tartar: Put this into a large Crucible, and with a ſtrong Fire burn and calcine it, (take great care that no Coal, or any thing elſe, falls in) till it becomes white from the intire conſumption of its Oil. Or, if you are in haſte, take ſome of the beſt Tartar, tie it up in wet brown Paper, and then cover it perfectly with bright live Coals, which will by this means be gradually extinguſh'd. Remove the Aſhes whilſt they continue hot, and at the bottom you will find a ſaline, alcaline Matter compacted into one Maſs, which is called common Salt of Tartar. Let either of theſe then be diſſolved in Water, ſtrain'd, inſpiſſated, and dried in a clean iron Pot, exactly in the manner deſcribed, Proceſs 12, Paragragh 4, and be then calcined, in the very ſame way as is mentioned Paragraph 5, ſo that it may be reduced to a fine Powder, which, in proportion to its ſubtlety, will be the fitter for this Operation. This is the beſt Salt of Tartar.

2. Let there be ready at the ſame time a very dry clean Bolthead, with a pretty large Mouth, and one third full of the choiceſt hot Alcohol, and let the whole Neck be made hot, for otherwiſe it wou'd crack when the hot Salt of Tartar came to run through it.

3. Make a kind of Funnel with Paper, and faſten it round the Mouth of the Bolthead, and when the Powder of the Salt of Tartar comes vaſtly hot from the Fire, and conſequently is exceeding dry, pour it through the Paper Funnel into the Alcohol contained in the hot Veſſel. If all theſe Circumſtances then

are rightly attended to, the Salt will run into the Alcohol, with a hiſſing noiſe, and the Alcohol will immediately boil with the Heat of it. When you have pour'd in enough Salt, ſtop the Bolthead lightly with a Cork, and as ſoon as all is grown cold, add ſuch a quantity of Alcohol more as is ſufficient to fill the Belly of the Bolthead three quarters full, and be ſure ſhake it well about, that no Salt may hang upon the Sides of the Neck, but may be abſolutely cover'd with the Alcohol, for otherwiſe theſe ſaline Particles wou'd be diſſolved by the moiſture of the Air, and running down wou'd mix with the Alcohol, and ſo render this tedious Operation ineffectual.

4. Let the Bolthead, thus charged, be plac'd in a Heat of a 100 degrees, ſtopt ſlightly, that the moiſture of the Air, which is here ſo miſchievous, may not be able to inſinuate itſelf; and let the Veſſel be frequently ſhook about. By this means then you will have a Liquor, of a beautiful deep red Colour, which will, by its Colour and Smell, tho' ſcarcely by any efferveſcence, plainly demonſtrate, that it is impregnated with the Vertue of the alcaline Salt, particularly, if the Liquor is examined after it has been very cautiouſly inſpiſſated by Diſtillation, for then it is evidently ſaponacious, and in ſome meaſure ſaline.

5. When there is the leaſt quantity of Water mixed with either of theſe Bodies, there will be no Tincture extracted, but the pure Alcohol will appear pellucid, and colourleſs, upon the Alcali, and will continue ſo, let it ſtand ever ſo long, and there will appear ſome mark of the moiſture, let it be ever ſo ſmall. It is not ſo ſtrange, therefore, that ſome famous Authors have aſſerted, that ſuch a Tincture as this is impoſſible, for the ſlighteſt neglect of but one, out of ſo many neceſſary cautions, will always render the Operation unſucceſsful. And as for what other Profeſſors in the Art have aſſerted, *viz.* that the Colour thus impreſs'd upon the Alcohol by our method, is in reality owing to the ſpontaneous alteration of the Alcohol by Time, this is confuted by the thing itſelf, as well as by the Qualities of the Tincture above-mentioned. Where ſo much Pains is neceſſary, an Error is very eaſy. I have not found this Tincture now to be alcaline, but rather of a compound, ſaponacious nature.

USE.

1. THIS very tedious Experiment demonſtrates again the averſeneſs there is in the nature of a pure fix'd Alcali to being alone, and its ſtrong diſpoſition to attract into it almoſt all kinds of Liquids. That it very greadily attracts Water, Acids, and Oils, has appeared already in the preceding Proceſſes, and here we ſee it attracts even Alcohol itſelf, though not ſo ſtrongly or tenaciouſly, as the former. Here too we diſcover a new ſort of Soap, and that an exceeding fine one, produced from an Alcali and Alcohol; for this Tincture evinces its true ſaponacious quality, by the deterſive power one perceives by rubbing it betwixt ones Fingers, whereas pure Alcohol only dries away. By its Taſte, too, it appears to contain a pretty acrid, igneous Salt. It does not, however, evidently cauſe an effervеſcence with Acids; nor does it readily precipitate Bodies diſſolv'd in them. If the pure Tincture is inſpiſſated by Diſtillation, it leaves a ſaponacious, ſaline *Coagulum*, conſiderably acrid, ſcarcely alcaline, and of a very deep red, nay, almoſt black Colour. By this *Menſtruum* diſtill'd Oils are ſpeedily and thoroughly diſſolv'd; and by this are extracted excellent

Tinctures from Gum Lac, Myrrh, and Amber. It is recommended internally by the Chemiſts, in thoſe Diſeaſes that ariſe from very obſtinate, tartareous Obſtructions; but to ſpeak honeſtly, it cannot be given ſafely, except it is diluted with Water, Wine, or ſome ſuch ſoft Liquor, for otherwiſe it inſtantly burns up thoſe parts of the Body to which it is applied. And ſince it is neceſſary, that it ſhou'd be weaken'd in this manner, to what purpoſe is the laborious depuration of the Alcohol, and troubleſome combination of it with the Alcali? For my own part, I confeſs, it is my Opinion, that the preceding Proceſs, which is performed with a great deal leſs trouble, affords us a more efficacious Medicine. This Operation, however, ought not, on this account, to be look'd upon as an inſignificant one, for we learn a great many things from it, and it has ſome excellent uſes, ſome of which we juſt now mention'd, and ſhall now proceed to relate the reſt.

2. I have often reflected upon that aſſertion of the great *Helmont*, p. 58, 86, that Spirits of Wine diſtill'd from Salt of Tartar that is thoroughly calcin'd, will be one half converted into Water. This I underſtood of ſtrong Spirit of Wine, once rectified, eſpecially, as p. 151, he ſays, the ſame thing may be done with Vinegar; as I took notice before, Proceſs 49. As the principal Followers however of *Van Helmont* maintain, that this muſt be underſtood in a very different manner, and that his true meaning was, that pure Alcohol wou'd unite one half of its Body with the Salt of Tartar, whilſt the other being turned into Water wou'd be repell'd, both from the former part, and the Salt combined with it, and that hence ſimple Alcohol conſiſts of two diſtinct parts ſeparable from one another, one of which is, by this means, together with the Salt of Tartar, converted into that noble Balſam, the *Samech* of *Paracelſus*, which to a miracle heals Wounds, without any inconvenience; for this reaſon, I ſay, I thought it worth while, candidly to lay before you, what I myſelf, without being ſparing of my Labour, have been able to diſcover. I prepar'd then a very choice, ſtrong, red Tincture of Salt of Tartar, according to the method deſcrib'd, which was of a very fragrant Smell, and an exceeding acrid, igneous, and almoſt alcaline Taſte. This I digeſted for ſome months with its Alcali, and then ſet them by for the ſpace of four years, after which time there was a very dry Salt at bottom, and an exceeding red Tincture at top. I inverted the Bolthead, and poured out all the Salt with the Tincture into a very dry clean Cucurbit, and I found 'em exceeding fragrant. With a gentle Fire, and perfectly cloſe Veſſels, I drew off all the Alcohol with an Alembic, and it was very limpid, ſubtil, and fragrant, whilſt the Salt at the bottom was of a ſcarlet Colour, though before it was white. I pour'd the Alcohol back again upon its Salt, and diſtilled as before, and then the Alcohol, which was of a fiery Taſte, roſe with a little more difficulty, and the ſaline Maſs that was left behind was of a deep red Colour, inclining to black. I cohobated in this manner one and twenty times, and then the ſaline *Reſiduum* was black, and the Alcohol that came off exceeding acrid. I urged this black, ſaline, alcaline Maſs, with the ſtrongeſt Sand Heat, and then there aſcended a Water, and not Alcohol. Hence then I ſaw, that though I had taken the greateſt care to prevent the acceſs of any Water, yet Water might thus be drawn from the Alcohol and Salt, but by no means to half the quantity of the Alcohol. And, indeed, I am hitherto in doubt, whether even the Water which was thus procur'd was not in reality

communicated to the Tincture; for in pouring the Alcohol ſo many times back again, and diſtilling it, perhaps ſome of the Moiſture of the Air might inſinuate itſelf into that and the alcaline Salt. This however I certainly diſcover'd, that Alcohol united with the Salt of Tartar in the manner deſcrib'd, then digeſted for ſo many months, afterwards ſet by for the ſpace of four years, and at laſt drawn off by Diſtillation two and twenty times, did not, after all, render this Salt volatile, but left it fix'd, and perfectly black. I then broke the Glaſs, and took out all the Salt, put it into a glaſs Baſon, and expoſed it to the Air in a ſubterraneous place, by which means it ran *per Deliquium* into a brown Liquor, of an acrid, alcaline Taſte, which I kept by itſelf. This Operation I went through, Gentlemen, in order to determine ſomething certain concerning this Tincture of Salt of Tartar; concerning Alcohol's being by this means converted into Water; concerning the Nature of Alcohol diſtill'd from Salt of Tartar that it was combin'd with; and concerning Salt of Tartar's being render'd volatile by the aſſiſtance of Alcohol. How eaſy is it for Perſons to grow rich in imagination from others promiſes? *Exitus acta probat.* The Alcohol now cohobated ſo many times, in the manner deſcrib'd, was very limpid, fragrant, and of an igneous Taſte, and burnt away without *Fæces*, nor wou'd cauſe any effervescence with an Acid. This, Gentlemen, was the Reward of my Labour.

PROCESS LXXXI.

An Elixir Proprietatis, *with diſtill'd Vinegar.*

APPARATUS.

TAKE of the choiceſt Aloes, Saffron, and Myrrh, cut and pounded, of each half an ounce, put 'em into a tall Bolthead, and pour upon 'em twenty times their weight of the ſharpeſt diſtill'd Wine Vinegar. Let them boil gently in our wooden Furnace for the ſpace of twelve hours, and then let 'em cool, and ſtand quiet, till the *Fæces* are ſubſided. Pour off the pure Liquor through a thin coarſe Cloth, taking care that none of the thicker part comes along with it. Upon the *Reſiduum* pour half the former quantity of freſh Vinegar, and then let 'em boil, cool, ſubſide, and be ſtrained, as before. Fling away what remains in the Bolthead, mix the Tinctures together, and diſtill with a gentle Fire till you have drawn off two thirds: The Vinegar that riſes ſet by for the ſame uſe another time; and the *Reſiduum* keep under the Title of an *Elixir Proprietatis with diſtill'd Vinegar.*

USE.

YOU have here an aromatic, acid Medicine, of infinite uſe in Phyſick. Externally it corrects, cleanſes, perſerves from corruption, and by its true balſamic Vertue defends putrid, ſanious, foul, ſinuous, fiſtulous, virulent Ulcers. It cures Gangrenes and Ulcers too of the Lips, Gums, Tongue, Palate, and *Fauces.* Internally it has the ſame happy effect, in thoſe Caſes where a putrid Matter, a fetid Bile, pituitous Concretion, or Worms, infeſt the firſt paſſages, and in an infinite number of Diſeaſes that ariſe from theſe four cauſes; nor is it much leſs efficacious in the Blood, and the inmoſt receſſes of the *Viſcera*, as is eaſily conceivable from the Nature of the Ingredients which are here diſſolved by a ſubtil Acid. This Elixir ſhou'd be taken in a morning faſting, twelve hours at leaſt after the laſt Meal. It may be given from one drachm to two or three, in Honey and Water, Mead, or ſome ſweet ſoft Wine, and the Patient ſhou'd walk after it, or have his *Abdomen* gently rubb'd; and this may be continued and repeated as is neceſſary. If it is taken in a larger Doſe, and with a cooliſh Regimen, it always purges by ſtool. When it is divided into ſmaller Doſes, it purifies the Blood by the ſecretion of a thick Urine, and for the moſt part effects both ſucceſſively. But if it is given in a pretty large Doſe, and the Patient is put in Bed, and well covered with Clothes, it excellently performs the Office of a generous Sudorific, in this particular ſcarcely yielding to any thing; and then it generally afterwards provokes a diſcharge, both by Stool and Urine, and thus all three ways is of ſervice. This therefore I look upon as an admirable *Elixir Proprietatis*, truly endued with many Vertues, and at the ſame time ſufficiently ſafe. *Paracelſus* aſſerted, that an Elixir prepared from Aloes, Saffron, and Myrrh, by intimately inſinuating itſelf into the vivifying, and preſerving Balſam of Life, wou'd protract it, free from all Diſeaſes, to the utmoſt Limits it is poſſible for human Nature to reach to: This he called by the grand name of the *Elixir Hominis*, but conceal'd the Preparation. *Van Helmont* ſays, it can't be done without the help of the *Alcaheſt:* And honeſt *Crollius* adds Oil of Sulphur *per Campanam* for the *Menſtruum*, knowing that, according to *Paracelſus*'s Doctrine, an *Acidum Eſurinum* ſhou'd be one Ingredient in Medicines for the Stomach: But then both the Aloes and Myrrh are burnt, as it were, and grow as hard almoſt as a Stone, nor ſo readily afterwards diſſolve in Alcohol, and when the Elixir is uſed, it requires ſomewhat to dilute the acrid Acid. Hence I imagine, that a mild, oily, vegetable Acid is in this caſe a convenient and proper Solvent, with regard to medicinal Purpoſes. If to the *Elixir* prepar'd in this manner you add an equal quantity of Alcohol, it renders it more mild, balſamic, and efficacious. The *Pilulæ Ruffi*, or *Peſtilentiales*, it reſembles in every Quality, and may be uſed ſucceſsfully inſtead of 'em.

PROCESS LXXXII.

An Elixir Proprietatis, *with a diſtill'd ſimple Water.*

APPARATUS.

UPON Aloes, Saffron, and Myrrh, of each equal parts, reduced to a Powder, and put into a tall Bolthead, pour 20 times their weight of Scurvygraſs-water. Then treat them in the ſame manner, as in the preceding Proceſs, and let them be inſpiſſated as is there directed.

USE.

THIS excellent Elixir has this great fault, that if it is kept a good while, it grows mothery. Setting aſide this, it has very valuable Vertues, like thoſe we deſcribed in the preceding Proceſs, if you allow for the acid quality of the former: In particular, it purges exceeding well by Stool. Inſtead of Scurvygraſs-water, you may make uſe of any other aromatic one.

PROCESS LXXXIII.

An Elixir Proprietatis *by the help of the fix'd Alcali of Proceſs* 12.

APPARATUS.

1. TAKE the ſame *Species* as before, put them into a tall Bolthead, and pour as much Oil of Tartar *per Deliquium* upon them, as will reduce them to a kind of Pap of a moderate thickneſs. Stop the Mouth of the Bolthead, and digeſt them in our wooden Furnace, the longer the better, in a Heat of a 100 degrees, and by this protracted Digeſtion the Alcali will intimately reſolve the Aloes and Myrrh, and ſo properly diſpoſe them for this Operation.

2. The Bodies being thus prepared, let them be treated with any aromatic diſtill'd Water, in the ſame manner as was directed in the preceding Proceſs, and then you will have an alcaliſated *Elixir Proprietatis* with a diſtill'd Water.

3. Or upon the *Species* prepared in this manner, pour 20 times as much of the choiceſt Alcohol, and boil, according to our method, for the ſpace of 12 hours. When the Liquor is grown cold, and ſettled, gently pour off the clear Tincture from the ſubſiding *Fæces*. Add more Alcohol, boil, depurate, and decant as before, and ſo proceed till the Alcohol will diſſolve nothing more. Mix the Tinctures together, and inſpiſſate them with a gentle Fire till you have reduced them to an *Elixir*, nearly of the thickneſs of Oil of ſweet Almonds, which keep under the Title of an Alcaliſated Alcoholiſated *Elixir*, whoſe Vertues cannot be enough extoll'd.

4. If inſtead of Alcohol you make uſe of Spirit of Wine once rectified, you have a thicker Elixir, that is equally valuable.

5. Sometimes inſtead of Alcohol, or rectified Spirit of Wine, I have uſed a diſtill'd aromatic Spirit, both ſimple and compound (Proceſs 69, 70, 71, 72.) and by this means I have procured a noble *Elixir*, particularly with the compound Spirit of Proceſs 72.

USE.

THESE Preparations afford us a Medicine, which is very frequently made uſe of, and with great Succeſs, in all acid, auſtere, watery, cold, and pituitous Diſorders, Schirrus's, and Obſtructions, without any Inflammation. It purges through almoſt all the Emunctories of the Body, and in the mean time is grateful to the Nerves, and aſſiſts the Spirits. To the Female Sex it is a friendly Medicine, promoting the *Lochia*, *Menſes*, and Milk. In Worms it does ſervice, and is uſed with ſucceſs in one ſort of Scurvy. It is good for creating an Appetite, and happily ſupplies the defects of the Bile; and for this reaſon, Practitioners in the Art ſhould have great regard to it. It acts by vertue of the Alcali, the *Species*, and the Spirits, or diſtill'd Water you make uſe of, as you deſign it for various purpoſes.

PROCESS LXXXIV.

An Elixir Proprietatis *with tartariſated Tartar.*

APPARATUS.

UPON the ſame *Species* reduced to Powder, and put into a tall Bolthead, pour 3 times their weight of the Liquor of tartariſated Tartar, nicely prepared according to Proceſs 75. Stop the Veſſel, and digeſt for the ſpace of three days in a Heat of 150 degrees, and you will find the *Species* intirely diſſolved into a homogeneous Pap, much more efficaciouſly than either, by Vinegar, Water, or an Alcali. Add then 20 times as much Alcohol, in reſpect of the *Species*, and boil gently for the ſpace of twelve hours. When the whole is grown cold, and the Liquor by ſtanding has depoſited its *Fæces*, pour it off gently, and on the *Reſiduum* pour freſh Alcohol, and proceed as before, and repeat this till you have almoſt diſſolved the whole, and you will find that you will here have as little *Fæces* as in any of theſe Proceſſes. Mix all theſe Tinctures together, and with a gentle Fire inſpiſſate to the thickneſs of an Oil, and keep the Alcohol that comes off for the ſame uſe another time. You will then have a tartariſated alcoholiſated *Elixir.*

USE.

THIS Preparation being made with a Compound Salt that is wonderfully aperient, is more efficacious than the preceding *Elixirs.* Hence it is of admirable ſervice in inveterate Obſtructions in chronical Diſeaſes, which it moſt powerfully reſolves, without any injury from an acid, or alcaline Acrimony: For theſe compound Salts paſs more freely with their diſſolved Subſtances through the Veſſels of the human Body.

PROCESS LXXXV.

An Elixir Proprietatis *with regenerated Tartar.*

APPARATUS.

UPON the Powder of the aforementioned *Species* diſpoſed in a tall Bolthead, pour 3 times as much of the Liquor of regenerated Tartar, and digeſt for three days, by which means the Aloes and Myrrh will be almoſt wholly diſſolved, and the Saffron will be perfectly opened. Of the choiceſt Alcohol, then, add 20 times the weight of the Powder, and boil very gently for the ſpace of twelve hours. Proceed in the ſame manner as before, and at laſt there will remain a few *Fæces* to be thrown away. Inſpiſſate the Liquors to one half, and keep the Alcohol for the ſame uſe. You will by this means then have a thick, turbid *Elixir,* which will always continue ſo.

USE.

1. IN this Proceſs, almoſt the whole *Species* is ſo equally diſſolv'd, that it is render'd potable, and hence in moſt chronical caſes I have found this *Elixir* to have an incomparable reſolvent and aperient Power; for it kindly diſſolves the Concretions with which the Veſſels are obſtructed, and at the ſame time gently ſtimulates the nervous Syſtem into a regular motion, by which it diſlodges and propels onwards the diſſolved Matter. Hence it reſiſts Putrefaction, which happens ſo frequently, and with ſo pernicious an effect in theſe caſes, it frees the *Viſcera*, and reſtores them to their proper office which was before prevented by the obſtructing Matter, and thus reſolves Tumours, and cures many Diſtempers which will not eaſily give way to any thing elſe. This therefore ſeems almoſt to me to be the *Elixir* of *Paracelſus* and *Van Helmont.*

2. From all theſe Operations, then, we have an example of a chemical Solution, and Preparation of the ſame thing with various Solvents. Hence too we learn, how wonderfully theſe Bodies differ in their power of acting, according to the difference of the *Menſtruums* they are diſſolv'd with; and conſequently, that to anſwer various views of the Phyſician, the Solution and Preparation muſt be varied likewiſe. According as they are variouſly determined too by the mixture of other Medicines with them, they are found likewiſe to have different effects. If they are given, for inſtance, with *Theriaca*, they promote Sweat; if with a purgative Medicine, they purge by Stool; and if with Whey, or medicinal Waters, and the Patient walks about in the cool, they operate by Urine. All theſe *Elixirs*, except that prepared with a diſtill'd Water, preſerve the Bodies that are put into them from Putrefaction; and to carious Bones too, they are particularly beneficial, except thoſe that are made with Acids. In Practice, therefore, let a great regard be had to them, for they have truly many excellent Vertues. Nor indeed, if we will but reflect upon the Ingredients, will this appear at all ſurpriſing: For Saffron greatly enlivens the animal Spirits; Aloes is a ſafe, and beautiful Purge; and Myrrh moſt efficaciouſly reſiſts Putrefaction. In thoſe caſes, however, where the *Craſis* of the Blood is broken, there are large Hæmorrhages, Hæmorrhoidal Diſorders, or too ſwift a circulation of the Fluids, theſe are by no means convenient, but on the contrary, prove prejudicial.

PROCESS LXXXVI.

The Analyſis *of Soot.*

APPARATUS.

1. I Here take ſome very black, dry Soot, collected from a Baker's Chimney where they bake nothing but Bread, for which reaſon I had it from the publick Bakehouſe, appointed for baking the Bread for the Poor: And it ought to be procured when the Weather is very dry. With this I fill a very large glaſs Retort almoſt to the Neck, and after I have carefully wiped the inſide of the Neck, with a common Lute made of Linſeed-flower, I lute on a large Receiver.

2. Let

2. Let there be then raiſed a Fire of 150 degrees, and let it be kept juſt to that height, and there will come off a large quantity of pure Water. And this will riſe with ſome *Impetus*, ſo that if the Fire is made too ſtrong at firſt, the Receiver will be eaſily crack'd. Proceed with this Heat ſo long as any of this limpid Water comes over, which generally continues a pretty while, tho' the Soot is ſo dry.

3. Having removed this Water, and put it into a Bottle, fix on the Receiver again, and raiſe the Fire to 200 degrees, and ſomewhat more, and you will then have a white, milky, pinguious Water, which will come off plentifully too, and with a conſiderable *Impetus*. Proceed to increaſe your Fire gently, ſo long as any of this Water riſes, and keep this again by itſelf.

4. Your Receiver being applied again, make your Fire ſtill ſtronger, and there will aſcend a yellow volatile Salt in great quantity, which will fix itſelf to all parts of the Receiver: Urge this ſo long as it appears to riſe.

5. At the ſame time too, with the ſtrongeſt ſand Heat, *viz.* a ſuppreſſing one, you will have a black, thick Oil.

6. The whole, then, being ſuffer'd to cool gradually, you will find a Salt in the Neck of the Retort, which notwithſtanding the violence of the Fire, was able to riſe no farther. And at the bottom of the Retort, there will remain a black *Caput mortuum*, whoſe upper Surface, however, will be cover'd over with a very thick, greyiſh, ſaline Cruſt, which in its colour, figure, manner of concretion, and *Striæ*, is exceeding like the common *Sal-Ammoniac.*

7. If the milky Water is rectified, it yields a very penetrating volatile Spirit, and ſomewhat of an oily volatile Salt that is conſiderably acrid.

USE.

THIS Proceſs, Gentlemen, was abſolutely neceſſary to be added to the preceding; for they have exhibited to us only thoſe parts of Vegetables, which by various Methods of treatment, and with different degrees of Fire, have either remained fixed, or have been tranſmitted from one Veſſel to another. But here we learn farther, what it is that an open Fire, whilſt it is conſuming Vegetables, puts in motion, changes, expells, and diſſipates into the Air, firſt in form of Smoke, then of Flame, and then of an Exhalation, and to what a conſiderable height it carries them. For a Chimney is a kind of converging Alembic, open at top, and often more than forty feet high, to the very higheſt part of which the Soot fixes itſelf, and a black Smoke is ſtill carried out of the Mouth, and diſperſed through the Air, in which one perceives it gradually vaniſh. When you reflect, therefore, upon theſe things, you conceive what an immenſe quantity of ſuch Corpuſcles muſt be carried up from the whole Surface of the Earth by the infinite number of Fires that are continually burning upon it. But we learn likewiſe, that a combuſtible Vegetable, its Smoke, the Flame ariſing hence, the Soot by this means produced, and the black Clouds diſperſed through the Air, conſiſt of one and the ſame Matter, put in agitation by the Fire. What Bodies are they, now, that enter into the Compoſition of this Matter? Why,

1. A fetid, oily, bitter, diſagreeable, nauſeous Spirit, which diſcovers itſelf in the Water that firſt comes off, and is diſperſed likewiſe through

all the other parts, hereafter mentioned. This ſeems to be the moſt ſubtil oily part of the Vegetable, ſeparated by the action of the Fire.

2. Elementary Water, which is here in great abundance; for it is contained in this Spirit, in the firſt limpid Water, in the ſecond milky one, in the ſaline Spirit, in the volatile Salt, nay, and even in the Oil itſelf. This Water, however, can ſcarcely be rendered pure by any Art whatever, for it always retains a bitterneſs, and a diſagreeable Smell of the Spirit, from which it cannot be freed.
3. An acrid, oily, volatile, alcaline Salt, which comes off firſt, riſes quite into the Receiver, and fixes itſelf to its ſides: For this Salt, by its Smell, Taſte, cauſtic Quality, violent Effervefcence with Acids, and Concretion with them into a compound Salt, I have found to be truly alcaline. Hence the Fires that are perpetually burning muſt fill the Atmoſphere with vaſt quantities of a volatile Alcali.
4. An acrid, pinguious, alcaline Spirit, which conſiſts of the Salt juſt mention'd diſſolv'd in Water, and thus by its liquidneſs, penetrability, ſubtlety, and volatility, reſembles a Spirit.
5. A thick, black, fetid Oil, which is exceeding bitter, nauſeous, inflammable, acrid, and almoſt cauſtic, and is mix'd with an oily Salt.
6. A true *Sal-Ammoniac*, which riſes to the lower part of the Neck of the Retort, and covers over the black *Fæces* at the bottom: For if you carefully collect, and nicely ſeparate this from the Salt that came off before, you will find it a true *Sal-Ammoniac:* It is of a whitiſh Colour, ſubpellucid, of a ſaline Taſte like that of *Sal-Ammoniac*, almoſt of the ſame Smell, will not cauſe an Effervefcence with Acids, but being mixed with fix'd Alcali's yields a true volatile alcaline Salt, as *Sal-Ammoniac* does. From Soot, therefore, we learn the true origin of this Salt.
7. An exceeding fix'd black Earth, which being calcin'd with an open Fire till the Oil which very tenaciouſly adheres to it is conſum'd, leaves an earthy white *Calx*.

This then, Gentlemen, is the true *Analyſis* of Soot. Conſider this well, and hence you will learn what parts of Vegetables become volatile, when they are expoſed to an open Fire, and what remain fix'd; and what parts of Vegetables are diſſipated by Fire into the Air. But here you ſee likewiſe, that even the Earth itſelf, which when it is ſeparated from the other parts is found to be ſo fix'd in the moſt intenſe Fire, may nevertheleſs, when it is combined with them, be raiſed by the action of the Flame and Fire to the height of more than forty feet, and be then carried along in the Air in form of a thin Cloud. But ſhould I, with a philoſophical view, enter into theſe things too minutely, there would be no end. I leave the matter, therefore, to your own meditation, and will only add, that ſome Perſons recommend Pills made of dry Soot, and then gilt over, as ſerviceable in very cold Diſorders: The volatile Salt of Soot too is preſcribed for the ſame purpoſes, as that of Animals, and uſed with the ſame ſucceſs: And the laſt Salt *Hartman* praiſes, as having a power of mitigating Cancers; and certainly *Sal-Ammoniac*, prudently adminiſtred, reſiſts its putrid diſpoſition, and ſo does this. But here it is abſolutely neceſſary to remember, that that Soot generated from pure burning Oak, our bituminous Turfs, or foſſil Coals, by a chemical *Analyſis* will be found to be different. And that would be ſtill of a more different nature, that ſhould be collected from the Chimney of a great Man's Kitchen, which is conſtantly full, not only of the Smoke of the Fuel, but of the Fumes likewiſe of all ſorts of boiled, roaſted, and fried animal Subſtances. Have an Eye therefore to theſe circumſtances, and you'll ſufficiently underſtand the Compoſition of Soot.

PROCESS LXXXVII.

The Analyſis *of Amber.*

APPARATUS.

1. I Take a large Retort, whoſe Neck is cut off ſo low, that the diameter of its Mouth is two inches or better. Into this I put ſuch a quantity of pieces of common Amber, well freed from Sand, Duſt, and other heterogeneous Bodies, as will fill the Belly of it two thirds full, and then, with the common Lute, lute on a large Receiver.

2. I then proceed to diſtill with a ſand Head a little greater than that of boiling Water, and by this means there comes off a large quantity of a thin, limpid Oil. This degree of Fire I keep up ſo long as the Amber gives out any of this Oil, which ceaſing, I remove it, and keep it by itſelf.

3. The Receiver being again fix'd on, there riſes another Oil which comes over plentifully likewiſe, and is yellow, and as yet pellucid. Patiently then keep up the Fire juſt to the ſame height, till no more of this Oil aſcends, which will be a conſiderable time. This again, which is yellow, inclining to red, and thicker than the former, if you would proceed accurately, muſt be kept by itſelf.

4. This being remov'd, and your Fire being ſtill gradually increaſed, there will begin to appear ſome white ſaline Flakes in the Receiver, eſpecially in the Neck, upon which you muſt gently raiſe your Fire till no more of this Matter comes away; for otherwiſe, the volatile Salt will be mix'd with the ſucceeding thick Oil, and ſo the greateſt part of it will be loſt. It's better to collect it by itſelf, and remove it. All the time, however, that this Salt continues to riſe, there riſes with it a red Oil, which is nearly pellucid.

5. The Fire being then raiſed to the greateſt degree, you have another, thick, tenacious Oil, nearly of the conſiſtence of Turpentine.

6. And laſtly, this being ſeparated, and the *Reſiduum* being ſtill farther urg'd with a ſuppreſſing Fire, a black flatulent Matter aſcends all together into the Neck of the Retort, which it fills up, and in this manner comes black, and hard into the Receiver. And hence it has happen'd, that where the Mouth of the Retort has been narrow, this pitchy ſtuff has quite ſtopt it up, by which means the Veſſel has been burſt with a violent exploſion, and this combuſtible Matter has in a dangerous manner ſet Fire to the things about it: If you mix a pretty deal of Sand, however, with this laſt *Reſiduum* before you urge it with this extreme Heat, it will by this means be ſo divided that it won't unite again, but will without any inconvenience come over black and hard into the Receiver. By proceeding in this manner, I have found there has been left but very little brittle *Fæces* at the bottom of the Retort, ſcarce worth taking notice of, ſo that the whole becomes volatile.

7. If the Operation is performed with proper care, the Amber may be ſeparated into all the diſtinct parts we have mentioned, which being afterwards diſtill'd by themſelves, may be depurated, and render'd thin and limpid. As for the volatile Salt, this being collected by itſelf is perfectly acid, and this is the only method I am acquainted with of obtaining a true Acid, in a ſolid, ſaline form; for this, I confeſs, I have not met with beſides, either in the Vegetable, Animal, or Foſſil Kingdom: Tartar, tho' it is acid, is ſcarcely a Salt diſſoluble in Water; and Oil of Vitriol, purified in the moſt ſkilful manner, will harden indeed with the Winter's Cold into pellucid Glebules, but as ſoon as ever the ſeverity of the Cold is a little abated, will melt again, and become fluid. This Salt of Amber keeps its ſolid form for a conſiderable time.

USE.

BY this Proceſs then, it appears, that Amber is a pretty ſingular Body. In its Oils, it comes near to *Petroleum*, *Naphtha*, and the like, and conſequently to pinguious Foſſils. In the part that remains after the firſt and ſecond Oil are ſeparated, it very much reſembles the black *Lapis Gagates*, or Jet. And again in its acid Salt, it has ſome reſemblance to Vitriol. I have been at a loſs, therefore, where I ſhould properly place this *Analyſis* of Amber, and at laſt I placed it here, that we might reſolve it into its parts, if it had been for no other reaſon, than that it will almoſt totally diſſolve in Alcohol, and will not by this means be ſeparated into different parts, but only become looſely as it were concreted together according to Proceſs 58. How vaſtly different now is the ſame Subſtance, whilſt it continues in one Maſs, from thoſe parts into which it may be reduced by the Chemical Art? Who cou'd imagine that Amber, its Powder, a liquid Solution of it in the pureſt Alcohol, the Powder precipitated from this Tincture inſpiſſated and then mixed with Water, and the Oils, Salts, and Colophony produced by Diſtillation, ſhould ariſe from the very ſame Matter? Who can diſcover any agreement in the Vertues of theſe different Bodies? Or who by compounding them together, can ever produce Amber again? Theſe Oils properly rectified by a freſh diſtillation, have an acrid, balſamic, inciting, diaphoretic, and diuretic Vertue, are uſeful in hyſteric caſes, and bring down the *Menſes*. Externally too they are rubb'd with ſucceſs upon torpid, contracted, weak, and paralytic Limbs. The volatile Salt is a true oily, acid one, valuable for its grateful, balſamic, pinguious, penetrable, antiſeptic Acidity, by which it ſtimulates the Nerves, and raiſes the Spirits. Hence it holds the firſt place among the Anti-hyſterics, and Diuretics, eſpecially if it is rectified by a new Sublimation.

PROCESS LXXXVIII.

Putrefaction of Vegetables.

APPARATUS.

1. IF the ſoft ſucculent parts of freſh Vegetables, are put in the Summer time into a wooden Veſſel open at top, and preſs'd down in it till the Veſſel is

almoſt full, and are left in theſe circumſtances expoſed to the open Air, they will in a ſhort time ſpontaniouſly grow warm, and the Heat will daily increaſe more and more, eſpecially in the middle, till it will at laſt exceed that of boiling Water, riſing ſo much the higher, as the Herb is more compreſs'd together, and is leſs watery, provided it is not dry. When this Heat is arrived to its greateſt degree, it gradually diminiſhes again till it returns to the common temperature of the Atmoſphere, and then the whole Vegetable Subſtance is reduc'd into a pretty equable pappy Matter. This Heat, now, begins to be generated in the center of the Body, is greateſt there, and thence diſperſes itſelf on every ſide, till it has taken poſſeſſion of the whole Maſs. Nor does it at all ſignify what kind of Vegetable you treat in this manner, whether it is the moſt alcaline, as Scurvygraſs; the moſt acid, as Sorrel; or the moſt inſipid, as Graſs. And here, whilſt the Heat continues moderate, *viz.* not exceeding 80 degrees, theſe Herbs, if they are naturally fragrant, diffuſe their proper Smell, and ſo long too they retain their particular Taſte; but as the Heat increaſes, the natural Smell is changed into ſuch a one as Hay, that is not well dry'd, gives out when it comes to grow hot; and when it is arrived to its greateſt degree, the proper Smell, Taſte, and Colour too, are intirely deſtroy'd, and inſtead of them, there ariſes a putrid ſtink reſembling that of Dung, and a cadaverous Taſte, like that of putrified Urine: The *Spiritus Rector* too is then quite gone off, and from the moſt different Vegetables, the Smell and Taſte are the ſame.

2. If Herbs cut down and half dry'd, but otherwiſe retaining their natural Juices, are flung up into large heaps, there will be a pretty ſtrong Smell diffuſed around, by which it will appear, that an igneous Motion begins to ariſe in the internal part of the heap, where it is moſt compreſs'd, tho' in the external there will as yet be none perceiv'd. If the whole heap is then flung abroad, and the Herb is expoſed to the Wind, the Putrefaction is prevented; but if it is left to itſelf in theſe circumſtances, the Heat increaſes to ſuch a height, that the middle intirely putrifies, grows very hot, and at laſt burſts out into open Flames. And here the bigger the heap is, and the heavier the Mater of which it conſiſts, ſo much the ſpeedier will the Putrefaction happen, and the Fire be excited. If the Heat now proceeds ſo far as to ſet the Vegetable on Fire, it will then ſuffer the very ſame alterations, as when it is burnt in a common Chimney: But if the heap grows very hot, but yet does not take fire, it will then putrify, and be converted into juſt ſuch a pappy Matter, as the preceeding. That this is often the caſe with Hay is known ſufficiently.

3. This phyſical action in Vegetables proceeds ſo much leſs efficaciouſly, as they are naturally drier, and leſs juicy, or are more dried before the Experiment is made with them; but even then, if you pour Water enough upon them to wet them thoroughly, a Putrefaction may be excited. The lighter too the Herbs lie upon one another, ſo as to leave empty ſpaces between, the leſs are they diſpoſed to generate this Heat; whereas when they are ſoft and ſucculent, and are ſtronger compreſs'd together, they grow hot, and putrify more certainly, and to a greater degree. Hence it comes to paſs, that the drier, harder Herbs, ſuch as Roſemary, for inſtance, ſcarcely putrify, if they are put into a Veſſel, except they are preſs'd together with a great weight, or there is a vaſt heap of them; tho' on the other hand too, if they are mix'd with too great a quantity of Water, they will acquire indeed a kind of rancidity, but will not generate ſuch a degree of Heat.

4. If you take this pappy Matter, when it is juſt thoroughly prepar'd, and put into a large glaſs Cucurbit, and diſtill it very cloſe almoſt to a dryneſs, you will have a limpid, fetid Water, which keep by itſelf. Let the *Reſiduum* then, rendered by this means almoſt dry, be put into a Retort, and be urged through all the ſucceſſive degrees of Heat, quite to the greateſt, and it will give out white Fumes, a large quantity of a thin Liquor, a white Salt, and a black, thick Oil. Let theſe be kept all by themſelves. The few black *Fæces* then that remain at the bottom of the Retort being taken out, burnt, and calcined with an open Fire, leave a mere Earth, without any fix'd Salt at all, tho' it is procured ſo acrid, and in ſuch abundance from moſt Vegetables when they are burnt before they have undergone this Putrefaction.

5. If you ſeparate the laſt Liquor from the Oil, and diſtill it to one half in a tall Veſſel, and with a gentle Fire, you will have an acrid, ſaline, alcaline, volatile Liquor. And if you treat this again in the ſame manner, you will ſtill have a ſtronger; and if you proceed to repeat this Operation, keeping your Veſſels very cloſe, you will at laſt procure a Liquor very much reſembling rectified Spirit of Hartſhorn, which with a gentle Fire will yield a true volatile Salt, in great quantity, nay in a greater than the Herb would have produced fix'd Salt before the Putrefaction. From the firſt Liquor too you may in the ſame manner obtain ſuch a Spirit, and a Salt, which being thoroughly rectified, are perfectly like the Salt, and Spirit of Animals, without any chemical difference. And this is the caſe with the ſoureſt Sorrel.

6. The thick black Oil, too, that is forced out with the laſt degree of Heat, and ſtinks intolerably, and retains its fetid Smell very ſtrongly, by theſe qualities, as well as its pitchy tenacity, exactly reſembles that Oil which animal Subſtances yield when they are expoſed to the extreme torture of the Fire.

USE.

THE phyſical action we have now explain'd is call'd Putrefaction; which, without any aſſiſtance of Art, happens ſpontaneouſly to Vegetables, whenever they are juicy, and are laid in great heaps, or compreſs'd together. And the power of this action extends to all Vegetables in general, and converts them all into the ſame kind of Matter, tho' they are ever ſo different before. And it renders the whole of them volatile, except only a ſmall quantity of Earth, ſo that no Operation fills the Atmoſphere with more acrid, and even peſtilential Particles: This the Stench that ſpreads itſelf to ſuch a diſtance from putrifying Bodies ſufficiently evinces, which drives People, even without deſign, from ſuch infected places. Since therefore this Putrefaction, ſooner or later, intimately reſolves both the Fluids and Solids into a ſoft, ſtinking, tabid, liquid Matter, it is plain that by means of this, and the Rain that dilutes it, every thing that grows out of the Earth may penetrate and inſinuate itſelf into the Earth again. Nor is this the caſe only with thoſe parts that continue upon the Earth after Putrefaction, but even thoſe, that become ſo volatile by this means as to be carried up into the Air, intermix themſelves with Dew, Fogs, Rain, Hail, and Snow, and with them deſcend again, and ſink into its Boſom. Neither in Art or Nature, now, do we find any one Operation ſo general as this; for it acts upon every kind of Vegetable, in the ſame manner, and with the ſame effect.

Acid, auſtere, alcaleſcent, aromatic, hot, cold, oily, watery, and ſaline Plants it reduces to the very ſame circumſtances. The particular Make, Smell, Taſte, Colour, and proper Vertue of them all, are by this means abſolutely deſtroy'd, and they become one and the ſame Matter, *viz.* a liquid Pap, of a greyiſh Colour, reſembling in every Character the gangrenous *Sanies* obſerved in the corruption of Animals; or coming pretty near to that Alteration which Vegetables undergo in healthy animal Bodies, when they paſs out of the Body in form of putrid Excrements. And here the ſtronger and more violent the vital Actions of Animals are, either from Motion, or a Fever, the nearer does the effect it has upon vegetable Subſtances come to the true Putrefaction of them. Of all Operations therefore, both artificial, and natural, Putrefaction beſt explains the firſt Action of the Mouth, Stomach, and Inteſtines; and conſequently, the Opinion of *Pliſtonicus*, who aſſerted that our Food receives the greateſt alteration in the Stomach and Bowels from Putrefaction, ought not to be ſo intirely exploded. This Putrefaction now muſt be abſolutely diſtinguiſhed from that Fermentation which we regularly explained, Proceſs 42, from p. . to p. . and for this reaſon in particular, becauſe ſome famous Men in the Art too much confound together theſe two things, which I think ought to be regarded as intirely diſtinct from one another. With the leave then of thoſe Gentlemen, who differ from us, I'll freely propoſe the Circumſtances in which it appears to me that they principally differ; which are as follow.

1. A greater Thickneſs, Compreſſion, and Denſity, ſeems neceſſary to the Putrefaction of Vegetables, than to their Fermentation.
2. Putrefaction acts upon all Vegetables, of every kind whatſoever, provided they are ſoft and ſucculent: Fermentation acts upon ſome ſorts only, and does not at all affect others.
3. The Heat which is neceſſary to Putrefaction, and is ſpontaneouſly excited by it, begins at the degree of Heat of a Man in health, and riſes even to burſting out into Flames; whereas, if in Fermentation the Heat increaſes to that of a healthy human Body, the fermenting Cauſe is diſſipated, and the Liquor grows vapid. Nay indeed, the Heat excited by Fermentation, does not exceed 75 degrees, except in the Fermentation of Vinegar, and even then if it is not immediately check'd, the true acetoſe Fermentation will not proceed, but the Liquor will be corrupted, and grow flat.
4. But the Effects of them are different likewiſe: For Putrefaction renders all the Salts volatile and alcaline, the Oils very fetid and volatile, and almoſt volatilizes the Earth itſelf; Fermentation on the contrary makes the Acids volatile, thin, and of an oppoſite nature to that of an Alcali, renders the fragrant ſpirituous parts inflammable, produces an acid Tartar, and leaves that Matter, which the Fire converts into an Alcali, as fix'd as it was before.
5. But there is a difference betwixt them too in their Salts, thoſe generated by Putrefaction, which from all vegetable Subſtances are the very ſame, being ſimple, alcaline, fetid, and exceeding volatile; whereas thoſe which Fermentation produces, are acid, for the moſt part fix'd, and compounded of a Spirit, Oil, Salt, and Earth.
6. And laſtly, Putrefaction furniſhes us with a method of abſolutely, and certainly

certainly converting all the ſaline Matter of Vegetables, into one and the ſame ſimple volatile Alcali: Fermentation changes a certain ſmall portion of the vegetable Salts only into a volatile, acid Liquid, and leaves the reſt almoſt without alteration. If any Perſon now, after duly conſidering what we have here offered, is ſtill of Opinion that theſe Operations ought not to be diſtinguiſhed, and that this would be only multiplying *Species* of things to no purpoſe, I ſhall oppoſe it no farther, for indeed I know no other kind of Arguments that can be made uſe of in the Chemical Art. It may be added too, that Fermentation, with a ſmall degree of Heat diſſolves the latent Air, which by the concourſe of its Elements puts in motion, attenuates, agitates, and diſſolves the viſcidity of the fermentable Subſtances, with a conſtant Ebullition, and for a certain ſpace of time, and generates, or ſets free the inflammable Spirits: Putrefaction, by means of a greater Heat, ſoon puts in motion, and expells the ſame Air, and quite changes the whole Matter. But let me caution you, that I am now treating only of the Putrefaction of Vegetables. Here then I put an end to theſe Proceſſes upon Vegetables, as this laſt changes them to a reſemblance of the humours of Animals, which now therefore we will proceed to examine. But upon the head of Putrefaction by all means conſult the famous Dr. *Cox. Phil. Tranſ.* No. 100. p. 7002. No. 101. p. 4.

CHEMICAL OPERATIONS,

PART II.

Upon ANIMALS.

INTRODUCTION.

IT appears therefore from the preceding Operation, that it is poſſible, nay, and that it very frequently happens, that Vegetables of all ſorts, having their different properties quite deſtroy'd, are converted into the ſame kind of new Matter, which can afterwards be ſcarcely diſtinguiſh'd. This I ſay is the caſe, whether they are acid, acrid, alcaline, bitter, aromatic, rough, ſmooth, hot, ſweet, inodorous, inſipid, medicinal, odorous, ſaline, ſapid, poiſonous, or cauſtic; for all theſe ſorts, and others, if there are any, loſe intirely their proper diſpoſition, and acquire a new common one, by which their Salts become alcalious, and are rendered volatile, and their Oils eaſily grow putrid, and become volatile likewiſe. And the very ſame thing happens to thoſe Vegetables which are taken as Food into animal Bodies. The chemical management of Vegetables, therefore, being already treated of, we ſhall be the better prepared to underſtand thoſe things which this Art performs upon Animals. But in order to do this ſtill more ſucceſsfully, it is neceſſary, from the *Hiſtoria Medica*, to lay before you the following Obſervations.

1. All Animals that we know of, by the very actions of Life, continually loſe thoſe parts, both fluid and ſolid, of which they conſiſt at any particular time. Their Hair, Nails, *Epidemis*, the extremities of all their Veſſels, and their internal and external Surfaces, teach this ſufficiently. This conſtant loſs now, happens from the caſting off of numberleſs minute Particles, which are either abraded, or ſimply expell'd, and which on account of their fineneſs are not diſcovered at all, or appear only in the form of Fluids. Perſpiration, Exhalation, Sweat, the *Mucus*, *Saliva*, Urine, Excrements, Seed, Hæmorrhoidal, and menſtrual Diſcharges, *Fœtus's*, After-births, *Lochia*, and Milk, are perpetually carrying off theſe Solids and Fluids both from Male and Female. And the reſtoration of the Bones to a ſound ſtate within a few weeks after they have been broken, nay and have even loſt part of their Subſtance, certainly evinces that there is in theſe a vital motion likewiſe.

2. In this reſpect, therefore, Animals do not ever continue the ſame as they were but a little before, but continually ſupply the loſt Particles from their Meat and Drink, and perhaps the Air; for *Bellini* found that the Chicken that came out of an Egg was, by being ſet upon, grown heavier than the Egg was when it is put under the Hen. The Body therefore conſiſts of thoſe Particles by which it is nouriſhed; for by means of theſe it grows from a Corpuſcle ſcarce weighing a grain, to the ſize it has when it is come to maturity. And as it thus increaſes by means of foreign ſubſtances, ſo when it is adult, and wears away, it is renewed again by the ſame, after they are firſt properly altered by the Animal Powers.

3. The Food of Animals conſiſts either of Vegetables, or other Animals, as the ſame, and Water furniſhes them with their drink. Foſſils have nothing at all to do here, except, perhaps, you wou'd add Sea-Salt, *Sal-Gem*, and Fountain-Salt; but that a Perſon may live without theſe, has appear'd by the example of whole Nations. The *Brachmans*, *Pythagoreans*, and others, by the aſſiſtance only of Vegetables, and Water, are healthy, and live to great ages.

4. Moſt of the Animals that Mankind makes uſe of for Food, live upon Vegetables, witneſs, Bullocks, Deer, Sheep, Goats, Hogs, Rabbits, and Hares. Some of the larger Fiſh, indeed, eat the leſs, or Inſects; and ſome Birds too prey upon Inſects, or other Animals: But thoſe Animals that help to ſupport others, very often live themſelves upon Vegetables, and therefore theſe we have firſt examined in the preceding Eighty eight Proceſſes.

5. The human Body therefore conſiſts principally of an aggregate of vegetable Subſtances: Thus if a Perſon eats Cow-Milk, Butter, Cheeſe, or Beef, the Animal that ſupplies him with them was itſelf made up intirely of Graſs, Hay, and Water.

6. Before the Chemiſt takes into conſideration the Body of an Animal that lives ſolely upon Vegetables, it is neceſſary, by his Art, to examine thoſe Vegetables. If he neglects this, he won't properly underſtand the Bodies of Animals; and hence has happened ſo much confuſion in this affair.

7. All the alterations that happen to Vegetables, and are obſervable by the Chemical Art, being explained, in our Chemical Examination of Animals we ought firſt to take under conſideration that part, which being of a vegetable Origin, begins in the animal Body to loſe its former nature, and put on the animal one, and which may be ſeparated from all the reſt, and examined by itſelf; that thus we may diſcover the ſucceſſive alterations of it, and then in particular when it retains a good deal of its natural diſpoſition: For by proceeding thus gradually, we ſhall get a clearer inſight into the Animal Nature of the human Body, for the ſake of which we take all this pains, than if we firſt ſet about examining a part that has been expoſed to all the actions of the Body, as is often prepoſterouſly done. An Animal conſiſts of a Matter, which at firſt was not that Animal, but by the powers of it was converted into the Animal Nature. This therefore you will beſt underſtand by beginning with the firſt alteration that happens in this foreign Matter, and then examining all the ſubſequent ones in their proper order through all the ſucceſſive degrees. After a good deal of conſideration, therefore, from whence I ſhould

I ſhould begin theſe Experiments, I perceiv'd that this cou'd not be done with the Contents of the Stomach; for as ſoon as the Vegetables come to be changed there, they paſs off in form of Chyle: And as for the Excrements that go off by Stool, they are depriv'd of the Chyle after it is made: And the Chyle of the Meſentery, and Thoracic Duct can ſcarcely be obtained in ſufficient quantity to be properly examined, nay, and then the greateſt part of it is lymph, diſcharged into it by the lymphatic Veins. The Milk therefore ſeems to offer itſelf as firſt to be conſidered: For it is true Chyle, much leſs diluted with Lymph than the ſame is when it enters the ſubclavian Vein, and conſequently in Nature comes nearer to the Aliments: This has circulated through the Veins, Heart, Lungs, and Arteries, and of courſe has been mixed with all the animal Humours, and being afterwards ſeparated by the particular make of the Paps, may be examined by itſelf. The Milk then is a Liquor produced from the Aliments chew'd, ſwallow'd, and digeſted in the Stomach; rendered more perfect by the Action, and Juices, of the Inteſtines; ſtill farther advanced by means of the Meſentery, its Glands and Humours, and the Thoracic Duct; having been expoſed to ſome of the actions of the Veins, Arteries, Heart, Lungs, and Humours of the Body; and conſequently beginning to be aſſimilated to the Animal Nature; and derivable out of the Body in ſuch a manner as to be examined alone.

9. By this their Milk, prepared from the proper Matter of the Chyle, all known Animals, that make Milk, are nouriſhed, both Male and Female: For in Men, as well as Women, there is always Milk generated from the Chyle; as there is in Virgins, barren Women, and thoſe that never gave ſuck, as well as in Mothers and Nurſes. Hence therefore every ſuch Animal conſiſts of, is nouriſhed by, and lives upon its Milk alone, and from that alone, by its vital Powers, forms all its parts, both ſolid and fluid. But it has appeared farther, that by the ſole aſſiſtance of Cow's, or other Milk, a Man may live for years in perfect health, and from thence prepare all the ſolid parts of the Body, and all the variety of Fluids in the greateſt perfection; as Bones, Cartilages, Membranes, Veſſels, Blood, *Serum*, Lymph, Spirits, *&c.* If a perſon therefore may live for a great number of years upon Milk alone, it neceſſarily follows that this muſt contain in it the Matter of all the parts of the human Body. Milk, now, approaches nearer to the Animal Nature, than Chyle: The Chyle of the Inteſtines has more of the nature of Vegetables: That in the Stomach moſt of all. And hence it comes to paſs, that in the Stomach and Inteſtines are obſerved the proper *Phænomena* of Fermentation and Putrefaction, as *Flatus's*, *Ructus's*, the generation of an Acid, a fetid Smell, and rumblings of the Bowels. For this Chyle is in reality a true Emulſion (Proceſs 21.) form'd by the action of the Teeth, Tongue, Stomach, and Inteſtines, with the aſſiſtance of the *Saliva*, and the gaſtric, pancreatic, hepatic, and inteſtinal Juices; and from this is procured the Milk. This, if it is good, when it comes to ſtand quiet in a Veſſel, at firſt appears exceeding white, and equally ſo throughout, but afterwards caſts up to the top a white, thick, pinguious Cream, whilſt that part which remains underneath, becomes clearer, bluiſh, thinner, and leſs fat than it was before, and is then call'd Skim-milk; and if you cautiouſly take off this Cream, the remainder will again give out more. In Emulſions

too, the caſe is the ſame. In this property now the Milk of all Animals agrees, as likewiſe in the whiteneſs of its Colour. In the Conſiſtence and Taſte, however, there is obſerved ſome difference: Thus human Milk is very ſweet and thin; to this ſucceeds that of the Aſs; then Mare's; next Goat's; and laſt of all Cow's. And hence to conſumptive Perſons whoſe *Viſcera* are exceeding weak, we preſcribe them in the order here mention'd. Tho' Milk however, in ſo many of its qualities, comes near to the nature of vegetable Emulſions, yet it is not quite the ſame: For the Runnet prepared from the Juices of the Ventricles of thoſe Animals that chew the Cud, upon being mixed with Milk, reduces it to a uniform, coagulated, ſciſſile Maſs, which ſoon ſeparates into a Whey, and a Curd fit for making of Cheeſe; which is not the caſe with Emulſions. If it boils a good while upon the Fire, the Liquid part is diſſipated, and it becomes thickened into a Butter, and Cheeſe, and is not converted into a homogeneous Maſs that will ſtand againſt the Knife, like *Serum* of Blood, or the white of an Egg. It has a ſweet Taſte, a Smell that is by no means diſagreeable, and is exceeding ſoft. It is a kind of middle Liquor between the *Serum* of the Blood, and an animal Emulſion, or Chyle: And hence it is of various ſorts, according to the difference of the Aliments it is made from, and the Animal that produces it. Theſe things then being premiſed, let us now take it under a Chemical Examination.

PROCESS LXXXIX.

Cow's Milk is not acid, contains no Alcali, is ſcarcely ſaline, nor has any of the Spirits in it of the Proceſſes 45 to 49.

APPARATUS.

1. NEITHER the Smell, nor Taſte of Milk, diſcovers any thing in it acid, alcalious, or ſaline; nor does it, when it is dropp'd into a ſound Eye, excite any ſenſe of Pain.

2. Into this, which is warm'd, I pour ſucceſſively a pure volatile, and fix'd Alcali, and there is not the leaſt indication, as you obſerve, of a latent Acid by any Effervеſcence, but it is diſturb'd, and ſomewhat inſpiſſated.

3. With another portion of this, I ſucceſſively mix the Acid of Vinegar, Nitre, Salt, and Vitriol, nor does there ariſe the leaſt Effervеſcence, by which we may infer the preſence of an Alcali; but it is coagulated, and thickened.

4. But this Milk now, which has ſome Oil of Tartar *per Deliquium* in it, I mix, in this cylindrical glaſs Veſſel, with this which contains ſome Oil of Vitriol, and there is excited in an inſtant the moſt rarified, rapid, violent Effervеſcence, much greater than would have happened from mixing together the ſame quantity of pure Acid and Alcali, as were in the Milk.

5. In this clean glaſs Cucurbit, with a Heat of about 160 degrees, I am diſtilling ſome new Milk with an Alembic; and there riſes a watery Liquor, which has not the leaſt appearance of a fermented vegetable Spirit. Nor does it by any Chemical Trial give the leaſt indication of its containing an Alcali, or an Acid: This you are eye witneſſes to, whilſt I mix it with oppoſite Salts,

and other things which we make uſe of to diſcover latent Acids and Alcali's. Nor farther does there appear the leaſt token of any thing ſaline in it; for it is inodorous, and inſipid, nor gives any pain to the very ſenſible external Coat of the Eye. At the bottom of the Cucurbit there remains a yellowiſh, thick, pinguious Maſs, which has a grateful ſweet Taſte: Nor even in this, examine it in what manner you pleaſe, can you yet diſcover any thing in the leaſt acid, alcalious, or ſaline.

USE.

THUS far then, Gentlemen, you truly underſtand the nature of that Fluid, produced from a vegetable Matter, which has been expos'd to the action of chewing, deglutition, rumination, and concoction of the Stomach, Inteſtines, Meſentery, Thoracic Duct, Veins, Arteries, Heart, and Lungs, in the animal Body; and which beſides was mix'd with the *Saliva*, the *Mucus* of the Mouth, *Fauces*, *Æſophagus*, Stomach, and Inteſtines, the Bile of the Gall-bladder, the hepatic and pancreatic Juices, the meſenteric and thoracic Lymph, and that of the Head, and laſtly with the Blood itſelf. Hence therefore there is no true Fermentation here, producing any thing acid or ſpirituous, no Putrefaction that cauſes an Alcaleſcence in the Salt, or a fetid Smell in the Oil, at leaſt as far as we can hitherto diſcover, notwithſtanding a great part of the animal humours are here mix'd with the vegetable Juices. We have a very different notion, therefore, of the chylopoietic and galactopoietic Functions, from what the Chemiſts generally give us. As Cows now are milk'd twice a day, hence this whole Operation muſt be perform'd in the animal Body within the ſpace of twelve Hours. If the Milk is retain'd any longer, it begins to change and degenerate from its proper Nature, and be corrupted. Theſe Experiments I have made with Cows Milk, becauſe they live ſolely upon Vegetables, either green, as Graſs, or dried, as Hay, and Water. In Womens Milk, on account of the great variety of their Food, there is ſometimes found ſome difference, though, when it is new, ſcarcely to be diſtinguiſhed. There have been ſome Perſons, now, who have aſſerted, that there is actually a latent Acid here, though it does not diſcover itſelf by the Experiments above-mention'd: But ſure theſe Gentlemen muſt allow, that an Acid is call'd an Acid, either as it affects our Senſes in a certain manner, or as it produces ſome particular effects; but neither of theſe is the Caſe here.

PROCESS XC.

New Cow's Milk is coagulated with Acids, even in that Heat which makes it boil.

APPARATUS.

IN theſe very clean Veſſels there is boiling ſome new Cow's Milk, diluted with a ſmall quantity of Water that it mayn't thicken too much as it boils. Into this then I pour ſome Vinegar, and the Milk turns immediately, forming a Curd with one part, whilſt the other ſtill remains fluid. Into a ſecond I pour

Spirit of Nitre; into a third Spirit of Salt; and into a fourth Oil of Vitriol; and the effect is in every one the ſame: Nor can this Coagulation be prevented even by a Heat of 212 degrees. It happens too with every other Acid, as the Juice of Sorrel, Berberries, and Citrons, Cream of Tartar, unripe Grapes, Currants, Tamarinds, Tartar, *&c.* So that here the Milk, which was of itſelf ſo thin as to be able to paſs through the fineſt arterial Canals, produces now a thick tenacious Subſtance, call'd the Curd, whilſt the other part, called the Whey, is a good deal thinner than the Milk was before. If this thick part, prepared either with an Acid, or common runnet, is very ſtrongly preſs'd in a thick Cloth, it forms a fat Cheeſe, which conſiſts of Cream, and that Subſtance which is properly called Cheeſe. This with age grows very ſtrong and acrid, does not become acid, but nearer in ſome meaſure to an alcaline diſpoſition, and acquires a particular ſtrong Smell, and a penetrating Taſte, which often inflames the Mouth. But if you firſt let the Milk ſtand, and take off the Cream, and afterwards turn it with an Acid, or Runnet, then the Cheeſe that is made from it will be exceeding dry, and grow hard, like Horn, and if you hold it to the Fire, it will, perfectly like that, grow ſoft, toaſt, burn, and ſtink. What a ſurprizing change do we here obſerve then of the very liquid Matter of Milk! But are not all the Solids form'd from this?

USE.

THIS then is the Nature of Milk as it is contained in the milky receptacles of the Breaſts. In them therefore, by the admixture of a ſalt Matter, like Runnet, or an Acid, it may be coagulated likewiſe. Hence the thin Whey will run out at the Nipple, whilſt the curdled part will remain in the Veſſels: Does it hence produce a Hardneſs, Swelling, Inflammation, Suppuration, Schirrus, and Cancer? May the ſame thing too happen in the chylous Glands of the Meſentery? In all theſe Coagulations with an Acid, however, the Milk retains its white Colour. Hence therefore it appears, that weak Bodies will be able to make chyle, and white Milk, but will with more difficulty make red Blood from them: And for this reaſon they abound with Acids, the Wind that breaks from their Stomachs is Acid, their very Sweat is Acid, they ſmell ſour, and are all over of a pale Colour. Theſe things then being rightly conſidered, the Phyſician may hence underſtand a great many Diſorders that happen to the human Body.

PROCESS XCI.

If new Cow's Milk is boil'd with a fix'd Alcali, it is coagulated, and grows yellow and red.

APPARATUS.

INTO new Cow's Milk, diluted with a little Water, and boiling in a clean Veſſel, drop in ſome Oil of Tartar *per Deliquium*, and it will grow yellow, and proportionably deeper, as you add more of the Alcali, and it boils longer; ſo that it will gradually from a pale yellow change till at laſt it becomes almoſt of a very deep red. But at the ſame time too it will be more and more coagulated, ſeparating into curdled Maſſes, which however are not ſo large, nor ſo ſolid, nor harden ſo eaſily as thoſe from the Acid. By this means, then, if you continue to boil it long enough, you will have a thick, red Curd.

USE.

HENCE therefore we ſee, that though Milk, when it is turn'd with an Acid, or its proper *Coagulum*, Runnet, even when it is hot retains its white Colour, yet it immediately grows yellow, by being mix'd with Alcali's in a great Heat, and by means of the Alcali and the Fire has its Colour gradually heighten'd more and more, till at laſt it becomes nearly red. And thus when a Woman that gives ſuck has a high Fever, the Milk corrupts in her Breaſts. Hence, from white, it grows yellowiſh, from ſweet, ſalt, from a moderate thickneſs, thin and ſanious the thicker coagulated part remaining in the Breaſts, and from inodorous, inclining to be fetid, ſo that the Child is not able to bear it. Where Milk therefore is obſerv'd coagulated with a yellow Colour, in a burning Fever, the Phyſician muſt not look upon this as ariſing from an Acid, but from too great Heat, and poſſibly an alcaleſcent degeneration of the Humours. And perhaps a Phyſician may ſee Milk coagulated in this manner a hundred times by a Fever, where he ſees it once happen from an Acid. In the laſt Murrain among the Cows, when the Ailment remain'd in the Stomach without being either brought up in chewing the Cud, or expell'd downwards by Stool, and underwent a true Putrefaction there with ſuch an incredible Heat as burnt and conſum'd the Stomach, perfectly as in Proceſs 88; then the Milk that was either milk'd from them, or ſpontaneouſly dropp'd out of their Teats, was thin, acrid, yellowiſh, and ſomewhat fetid. If with Milk now that is coagulated, either by an Acid, or Runnet, and ſtill remaining hot, I mix an Alcali, this does not, you obſerve, as is generally aſſerted, reduce the Curd again to its former Liquid; ſo that Alcali's do not always reſolve thoſe Subſtances that are coagulated by Acids. But from what has been ſaid, we farther underſtand, that Milk, which is exceeding white, will for a long time continue white in Bodies that are very weak and cold, nor can be brought to the natural redneſs of the Blood: Hence ſuch Perſons are always pale, and have a pale-colour'd thin Blood; though if by any means they are again reſtor'd to Health, they ſoon overcome this Paleneſs, and their Blood acquires a proper Colour. And for the ſame reaſons, when the vital Actions are capable in ſome meaſure of turning the Milk into Blood, but cannot quite perfect it, then the Colour of the Blood will be yellowiſh, not red; or greeniſh, like that of Girls that have the Greenſickneſs. But on the other hand, when the Body is healthy and ſtrong, and carries the Milk ſwiftly about, and gives it a conſiderable degree of Heat; then the white Colour is ſoon chang'd to a very red one, and the Blood often from the intenſeneſs of its Colour appears almoſt black. In the laſt place, from theſe Experiments we learn ſtill farther, that in Bodies that abound with Acids Milk will retain its Colour for a conſiderable time; whereas, if Alcali's are predominant, it will firſt acquire the Colour of Bile, and then gradually grow deeper and deeper, till it comes to be red. The white Colour now, according to the Obſervation of the famous Dr. *Lower*, diſappears by the twelfth hour from the laſt Meal.

PROCESS XCII.

Urine is not acid, nor alcalious, but fetid.

APPARATUS.

I HAVE here the Urine of a Perſon in Health, made twelve hours after he had either eaten or drank. This Liquid, therefore, was ſo long at leaſt in the human Body. And it did not circulate for much leſs time through the ſame Body, being mix'd by the vital Actions with all its Humours, and being propell'd, perhaps, through all its Veſſels. It is an aqueous *Lixivium* therefore that waſh'd off, united with itſelf, and now exhibits without the Body, whatever was capable of being diſſolv'd in Water, and tranſmitted through the fine uropoietic Veſſels of the Kidneys. For this reaſon it contains particularly the ſpirituous, ſaline, and ſaponacious parts of the Blood, and thoſe too pretty well concocted into the true nature of the animal Body, as they have been acted upon by the vital powers for the ſpace of twelve hours. Since therefore Milk itſelf loſes its natural diſpoſition in that time, and begins to be converted into *Serum*, hence for this chemical Examination I choſe that Urine, which was made when the cruder, ſeparated by the Kidneys before the twelfth hour after eating and drinking, had been diſcharg'd. Such Urine therefore may be always collected without the Body, and yet will perfectly diſcover to us the proper diſpoſition of the natural Humours, and their Elements. This Urine then is not acid; for it has not the leaſt Smell or Taſte of an Acid; it does not give thoſe vegetable Juices a red Colour that are obſerv'd to grow red with Acids; nor does this which is warm diſcover, as you ſee, the very leaſt ſign of an efferveſcence, when I drop into it, in one Veſſel, Oil of Tartar *per Deliquium*, and into another an alcaline Spirit of *Sal-Ammoniac*. Nay farther, which is more ſurprizing, I examin'd the Urine which a Perſon made twelve hours after he had drank a very large quantity of *Rheniſh* Wine, which was conſiderably acid, and ſtale Malt Liquor, and had at the ſame time eaten a good deal of Vinegar with his Victuals, beſides ripe Fruit, and yet even then it did not by any Experiment diſcover the leaſt ſign of an Acid. Nay, Urine that has been twelve hours in the tender Bodies of little Children that have liv'd almoſt intirely upon aceſcent Vegetables and Cow's Milk, has not appear'd to be acid by any effect. The vital powers therefore of the animal Body overcome both the natural diſpoſition of Vegetables to Acidity, and their real Acids. *Van Helmont* therefore aſſerted, with a great deal of reaſon, that an Acid is an Enemy to the Veins: But his Followers were abſolutely in the wrong, who hence, imagining Acids to do harm in the firſt paſſages, proſcrib'd them as Poiſons, both out of Diet and Medicine. Theſe Truths the Chemiſts will be diſpos'd to admit of: But they'll be a little ſhock'd, perhaps, when I aſſert, that this Urine is no ways alcalious; but this is abſolutely true, as you yourſelves may be Witneſſes if you'll pleaſe to attend. Into different portions then of this Urine made hot, I pour Vinegar, the Acid of Lemons, and Spirit of Nitre, Salt, and Vitriol, and there does not ariſe the leaſt Effervescence but the Acids mix with the Urine, without making any Noiſe, or forming any Bubbles, juſt as Water does with

Water. Nor does it change thoſe Juices of Vegetables green, which all alcaline Salts do.

USE.

HENCE then I infer, that the human Nature makes ſuch an alteration in Acids, that they continue ſo no longer, and that it prevents aceſcent Vegetables from growing actually acid. Whilſt a Perſon, however, continues in Health, he never generates alcaline Salts, but neutral ones. Nay, I have obſerv'd this to be true even in the Urine of Perſons, parch'd up with Heat in inflammatory Diſtempers, where, from the accelerated circulation of the Fluids, the Urine has been very high coloured, fetid, acrid, and in ſmall quantity; for upon examining their Urine in the manner above-mentioned there has not appear'd the leaſt ſign of an Alcali. I was ſtill in doubt, however, whether in a perfect *Iſcuria*, after the Urine has been retain'd, heated, and agitated for a conſiderable time, it might not by this means become truly alcalious. This I had afterwards an opportunity of examining, being ſent for to an old Gentleman who fell into this diſorder, and made no Water for more than five days. On the ſixth, however, to his great joy, he on a ſudden diſcharg'd ſome ounces of a red, thick Urine, that ſmelt very ſtrong; but the omen prov'd deceitful, for he never made a drop more till he died. This therefore I immediately carried home, and examined it in a chemical manner, but it did not even then appear alcaline by any Experiment. Hence therefore I learn'd, that Urine detain'd in the human Body for the ſpace of a hundred and twenty hours, was not, by the effect of its Heat and the action of Circulation, yet become alcaline; for this Water was not lodg'd in the Gentleman's Bladder: So that upon the whole it appears very evident, that no Alcali can be generated in any of the ſound Humours of a healthy Perſon, though it may be taken into the Body from without: Nay, that this never happens in the moſt putrid Diſtempers, whether acute or chronical. I confeſs, indeed, in an old Man, who was terribly afflicted with a large Stone in his Bladder, and was not fit to be cut, I obſerv'd the Water to have a urinous alcaline Smell. And as, from a Stoppage in his Water, he was often forc'd to have his Surgeon remove the Stone with his Catheter from the neck to the bottom of the Bladder, upon which the Urine ſpontaneouſly diſcharg'd itſelf, it happened once, when he wanted his aſſiſtance, that he was out of the way, ſo that he was forc'd to retain his Water for a good many hours after he had occaſion to diſcharge it; and hence when the Surgeon return'd, upon performing the uſual Operation, the Urine that flew out had ſuch an acrid, alcaline, fetid Smell, juſt as when it is putrified, that the Operator unwarily receiving the Vapour of it into his Lungs, felt the ill effect of it for ſome days. Hence therefore I am apt to believe, for the Water being ſpilt upon the Ground I had not an opportunity of examining it chemically; I ſay, I am hence apt to believe, that the Urine, by being attracted into the Pores of a ſpongy Stone in the Bladder, and lying there ſome time, may poſſibly, by means of the Heat it is expoſed to, acquire a true alcaline Acrimony. But be this as it will, this we are ſure of, that there is no natural alcaline Salt in the Urine. Neither is there, therefore, in any of the Humours of the human Body; for the Urine contains more Salt than any other Humour, and the Salts of the Urine are more acrid and alcaleſcent,

cent, and become ſooner truly alcalious than thoſe of any other Fluid in the Body. How much therefore are thoſe Artiſts miſtaken that maintain, that oily, alcaline volatile Salts are natural to the human Nature? This is an error which the chemical Art, cultivated not ſo cautiouſly as it ſhou'd be, has introduced into Phyſick, and which ſound Chemiſtry alone has corrected. The particular fetid Smell, therefore, of healthy Urine, is owing to an attenuated, putrid, volatile Oil, and not to a volatile, alcaline Salt. And the bitter, diſagreeable, ſalt Taſte of it depends upon a compound Salt, and an Oil, and generally ſome Sea-Salt, which is almoſt always amongſt it.

PROCESS XCIII.

If freſh Urine is diſtill'd in cloſe Veſſels, it yields a fetid nauſeous Water, neither alcaline, nor acid, but ſaline, nor ſpirituous like that which is drawn from Wine.

APPARATUS.

THE concocted Urine of healthy Perſons I diſtill in a clean glaſs Cucurbit, with a gentle Fire of 150 degrees, equably continued till there is only one twentieth part left, and there comes off a clear Water. The Urine, in the mean time, from its natural ſtraw-colour, grows gradually reddiſh, and in proportion, as more of this pellucid Water aſcends, it acquires a deeper and deeper Colour, till it at laſt becomes of a very deep red, nearly black, and is very thick, turbid, opake, and retains its Froth very tenaciouſly. The firſt limpid part diſtinguiſhes it ſelf by a ſingular, diſagreeable, nauſeous, fetid Smell, but not a volatile, alcaline one. And, which is pretty ſurprizing, if you repeat the Diſtillation of it a great many times, yet it always retains this fetid Smell; nay, if it ſtands expos'd a great while to the open Air, it does not loſe it. This fracid Smell, therefore, is intimately imprinted on this Liquor, even in ſuch a manner as not to be deſtroyed by the admixture of an Acid. Nor does it reſemble any thing ſo much as that ſtrong Smell which iſſues from the *Abdomen* of a living Perſon, when it happens to be laid open by a Wound, or that which riſes upon opening the Body of a Perſon that is juſt deſtroy'd by ſome ſudden Death. The Taſte of this Water is nauſeous, diſagreeable, putridiſh, not alcaline, nor ſaline, in any degree, perform your Diſtillation in what manner you pleaſe. Nor in this Diſtillation do there appear any Streaks in the Alembic, ſuch as ſpirituous Liquors diſcover themſelves by. Nay, if you take the Water that comes off firſt, and diſtill it again, you will not even then perceive the leaſt indication of any ſuch Spirit. And whenever I have examin'd it, it has by no means ſupported Flame, but always extinguiſh'd it, though it has been depurated ever ſo nicely. Nay, even from the concocted Urine of Perſons that have been uſed to drink freely of generous Malt Liquor, ſtrong Wine, and diſtill'd Spirits, there can no ſuch Spirits be drawn, which to ſome perhaps may ſeem a little ſurprizing. When I have mixed now this firſt Liquor that riſes from Urine, with any Acids whatever, I never cou'd excite the leaſt Effervesſcence; nor wou'd it change thoſe vegetable Juices green, which Alcali's will; nor cauſe any conſiderable precipitation of Bodies diſſolv'd by Acids; nor by rectification ever yield any viſible Salt; nor laſtly, ever convert any Acid into a compound neutral Salt: This Liquor, therefore, is not alcalious. And upon examining it by proper Experiments, it does not diſcover the leaſt appearance of an Acid, as you yourſelves are Witneſſes, whilſt I mix with it fix'd and volatile Alcali's, pour various Juices into it that grow red with Acids, and make the other Trials upon it formerly mention'd. What I aſſerted therefore appears very evident.

USE.

FROM this trifling Experiment, as it ſeems, we may learn a great many beautiful Truths, of very conſiderable conſequence in the Medicinal Art: Some of which give me leave to lay before you. The moſt light, thin, volatile part, then, of the animal Humours, in a ſound ſtate, is a Water, which is nearly elementary, except that there is inſeparably combin'd with it ſomewhat elſe, which is as light, thin, and volatile, and is fetid likewiſe, and diſcovers ſomething putrid, as it were, in it, being produc'd, not from a ſaline principle, but rather an oily one, and yet being by no means ſpirituous, fermented, or inflammable. In theſe Humours, therefore, there is no ſuch phyſical action as is obſerv'd in Fermentation, no production of ſuch Spirits as that generates, which are very eaſily ſeparated from their Water, whereas this fetid part cannot be ſeparated from its Water by any Art whatſoever. There is no volatile inflammable Spirit, therefore, in our Humours. The Oil in the human Body is rendered much more volatile by the vital Powers, than any of its Salt, tho' Perſons generally believe the contrary. This particular, fetid, oily principle now diſcovers itſelf ſcarce any where, but in *Sanctorius*'s perſpirable Matter, Sweat, and the Vapour, which is naturally contain'd in the cavities of the Body. Fermented, vegetable Spirits do not we ſee paſs to the urinary-paſſages? Do they tend upwards, therefore, and diſturb the Brain, the *Senſorium Commune*, and the Origin of the Nerves? Do they hence ſo wonderfully affect the functions of the *Cerebrum* and *Cerebellum?* And is this the reaſon that they exhale ſo eaſily from the ſurface of the Body? But from what has been ſaid we learn farther, that there is no Salt in the human Body ſo volatile as to riſe with the * Heat of boiling Water, notwithſtanding what the Chemiſts and Phyſicians think to the contrary. Nor is there any volatile Alcali there, either ſimple, or oily; nor any thing at all of a volatile Acid. What room therefore is there for correcting the modern medicinal Art upon this head? But again, this fetid Smell of the Urine increaſes in a healthy Body, as the Strength increaſes, and goes off again, proportionably, as that decreaſes. The more Exerciſe too a Perſon uſes, the ſtronger does his Urine ſmell; and the contrary. Upon the whole, then, if there is any thing in the animal Humours that, on account of its acrimony, volatility, lightneſs, and penetrability, ought to be call'd a Spirit, this is not vinous, or ſaline, but truly ariſes from an Oil degenerated into ſuch a putrid State as is deſcribed Proceſs 88.

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* This does not ſeem to appear from this Proceſs, for the Heat of boiling Water is about 212 degrees, that made uſe of here but 150.

PROCESS XCIV.

The freſh Urine that remains after the preceding Proceſs is neither acid, nor alcalious, but ſalt, and fetid, nor yet truly ſaponacious.

APPARATUS.

IF the thick *Reſiduum* of the preceding Proceſs is mix'd with any kind of Acid, or Alcali, whatever, it does not give the leaſt ſign of any effervеſcence, by which one can infer it to be either acid or alcaline. Nor does this appear to be the caſe by any other Trial. It is very acrid, indeed, and has a very ſalt and bitteriſh kind of Taſte, but not an alcaline one: Nor has it an alcaline Smell, but nearly ſuch a fetid one as it had before. If it is uſed in this condition by the Fullers, or the Perſons that clean Wool, it will not ſcour off the impurities, and conſequently, it has not then a lixivious, ſaponacious Quality, though it acquires ſo excellent a one by Putrefaction. During all this Inſpiſſation now there is never the leaſt appearance of any thing either milky or wheyey: Nor cou'd I ever, upon the niceſt Examination, diſcover the leaſt ſign of any ſuch *Coagulum* as the Lymph of the Lymphatic Veſſels, and the *Serum* of the Blood always form, when they are expoſed to Heat; nor, laſtly, does it ever diſcover any thing of the Nature of Cheeſe, treat it in whatever manner you pleaſe. But the more it is inſpiſſated by the Heat, the more acrid it conſtantly grows, and the deeper colour'd. And thus, through various degrees it alters, and increaſes in Colour, Conſiſtence, and Acrimony, and by this means runs through all the varieties of Urine, which one finds in acute and chronical Diſeaſes, as has been elegantly obſerv'd by the famous *Bellini*. In acute caſes, certainly, the higher the Fever is, and the more it diſſipates the Fluids, the redder, more acrid, and thicker is the Urine.

USE.

THERE is naturally therefore no Alcali, either fixed or volatile, in the Humours of a healthy Perſon; nor is there any fixed or volatile Acid there. But the Salt here is of a ſingular nature, which we ſhall hereafter examine, and is much leſs volatile than Water, not riſing even with the Heat that will make that boil. And, which is ſomewhat ſurprizing, there is no nutritious Matter ever contained in this Urine; for the Chyle, Milk, Cheeſe, and *Serum* that will be coagulated with Heat, and which the Phyſicians, with a great deal of reaſon, look upon as the only original Matter of Nutrition, are not diſcover'd here. No Nutriment therefore is carried out of the Body with the Urine. But on the contrary, the moſt acrid, putrid, ſubtle Particles, that are unfit for ſupplying any farther Nouriſhment, and wou'd injure the Body, having diſcharg'd their office of Nutrition, and being then ſeparated from the Chyle, Milk, Blood, and Fluids that are hence derived, are at laſt evacuated by the Kidneys. The Urine, therefore, exhibits to us thoſe Humours, that of all are by far the moſt changed by the powers of our Nature, and indeed too much to be of any farther advantage to the Body. The deficiency,

ciency, therefore, acrimony, colour, and thickneſs of the Urine, elegantly point out many things to the Phyſician, indicate the neceſſity there is of a ſupply of Water, diſcover the condition of the Humours, the ſtate of Diſeaſes, the Remedies that are to be made uſe of, and what in particular proves fatal to the Body, by breaking too much the *Craſis* of the Blood. How very injurious here is too great a degree of Fluidity!

PROCESS XCV.

The ſame Urine being inſpiſſated to one fortieth part, and then mix'd with Sand, and diſtill'd, yields an alcaline Spirit, a volatile alcaline Salt, a very fetid Oil, and a ſaline Caput Mortuum.

APPARATUS.

IF you continue the preceding Diſtillation of Urine till out of forty Pounds you have but one left, or if you take the ſame freſh Urine, and in a large, low, cylindrical, open Veſſel, evaporate it to one fortieth, and then mix either of theſe thick, blackiſh, acrid *Reſiduums*, with three times as much of the pureſt Sand, perfectly free from Salt, and diſtill in a glaſs Retort, with a Sand Heat, beginning with a gentle degree, and often removing the Receiver to examine the Liquors that come off; then, you will in the firſt place have a limpid Water, as in the preceding Proceſs. Afterwards, when the Maſs begins to grow almoſt dry, there will be a thin, limpid Liquor come over too, but it will be acrid, igneous, and alcaline: Continue the Operation ſo long as this aſcends, and keep it by itſelf. Then lute on the Receiver as cloſe as poſſible, and gradually increaſing your Fire, urge the *Reſiduum*, and there will begin to appear white Clouds, which will continue to riſe for a conſiderable time; after theſe you will obſerve ſome pinguious *Striæ*; then you will have a kind of oily yellowiſh Liquor, and with it a ſolid, alcaline, white Salt, a little inclining to the yellow; and laſtly, by the extreme torture of the Fire there will riſe a yellow or gold-colour'd Oil, which ceaſing, you will have ſome ſaline terreſtrial *Fæces* at the bottom. The firſt Water now is ſcarcely alcaline, acrid, or ſaline, and by no means oily, but like the Water of the preceding Proceſs. The ſecond watery Liquor has an evident, acrid, alcaline Smell; is cauſtic upon the Tongue, and has a perfect alcaline Taſte; cauſes a pretty violent Effervеſcence with all Acids; and ſaturated with a particular Acid, becomes concreted with it into a compound, neutral, ſemi-volatile Salt, then reſembling *Sal-Ammoniac*, but various in its Nature, according to the variety of the Acids it is combin'd with: It is truly alcaline, therefore, but volatile, like that of Proceſs 88. But all theſe things appear ſtill in a greater degree in the third pinguious Liquor, which is much more ſtongly alcaline, but at the ſame time, oily: Hence as it conſiſts of a Water, Salt, and Oil united together, it is call'd an alcaline Spirit. But again, all the Salt is conſtantly alcaline, but being render'd impure by the very fetid Oil that adheres to it, is very diſagreeable. And laſtly, the Oil that riſes with this afterwards is vaſtly fetid, contaminates every thing elſe with its ſtink, and is perfectly intolerable itſelf, not only diffuſing a urinous, but ſomething like a ſtercoraceous ſtench likewiſe. The *Fæces* then that remain at the bottom, being calcin'd with an open Fire and with Water made into a *Lixivium*, will give you a true Sea-Salt, if the Perſon whoſe Water you examine uſes to eat it.

USE.

HENCE then it appears, that our urinous Salt is not alcaline, but that it may be render'd ſo in a certain degree of Heat. It is evident likewiſe, that the Salt of our Urine is not a *Sal-Ammoniac*; for *Sal-Ammoniac* which is volatile in a certain degree of Heat, by ſublimation never becomes alcaline, but always remains compounded, and that, repeat the Operation ever ſo often; whereas Salt of Urine, which is of a ſemi-fix'd Nature, when is expos'd to ſuch a Heat as to render it volatile, becomes immediately alcaline, and intirely loſes its former character of a compound Salt. It approaches therefore both towards an alcaline, and an ammoniacal Salt, but is in reality neither one nor t'other. But hence we learn farther, that the Salt, ſaline Spirit, and firſt Oil, are nearly equally volatile in a ſound ſtate. It appears likewiſe that this pinguious Spirit is truly compounded of three different Principles, *viz.* a Water, Salt, and Oil, into which it may be conveniently reſolv'd again. From what has been ſaid too we underſtand the power of the human Nature, which thus converts the ſoft, white, inert, inodorous, pinguious part of the Aliment, Chyle, Milk, Fat, and Marrow, into ſomething acrid, yellow, inflaming, thin, and fetid, from which ariſes that diſagreeable ſmell of the Urine. And laſtly, hence we perceive that there is no fixed alcaline Salt in our Humours, as, in the greateſt quantity treated in this manner, I never cou'd diſcover the leaſt grain, but that Sea-Salt may enter into the Blood, be mixed with it, and may be carried off by the urinary paſſages, without any alteration, and conſequently, that it exerts its effects through moſt of the Veſſels of the Body, but is not chang'd by their reaction. Theſe things then being properly conſider'd, you'll acknowledge, that this ſingle Experiment is of vaſt uſe in Medicine, the honour of which is due to *Van Helmont*.

PROCESS XCVI.

Freſh Urine inſpiſſated and diſtill'd with a fix'd Alcali.

APPARATUS.

INTO freſh Urine, inſpiſſated in the manner deſcrib'd, pour an equal quantity of Oil of Tartar *per Deliquium*, or Pot-Aſhes, upon which there will inſtantly riſe an acrid, alcaline, volatile Vapour, juſt ſuch a one as exhales from putrified Urine when it begins to grow hot. If you immediately then diſtill this Mixture with a Cucurbit and Alembic, there will come off a limpid Liquor, running down as it were with *Striæ* like Spirits, which will be acrid, very alcaline, more volatile than Water, and in every mark reſembling a true ſtrong Alcali. If inſtead of the Oil *per Deliquium*, you uſe a very dry Salt of Tartar, you will frequently have a dry alcaline Salt riſe the firſt time from the Urine in Diſtillation. If the firſt alcaline Liquor is again diſtill'd in a tall Cucurbit with a gentle Fire, the firſt part that riſes is a white alcaline Salt, the Oil remaining at the bottom with the fix'd Alcali, as if it was thence render'd more fix'd. At laſt, however, after all is grown dry, if you urge the *Reſiduum* with an intenſe Fire, there will aſcend a fetid yellow Oil, likewiſe, but after this Salt.

USE.

FROM this Operation then it appears, that our urinous Salts are of ſuch a nature, that a fix'd alcaline Salt is capable of making ſuch an alteration in them in an inſtant, as the action of a ſtrong Fire did in the preceding Proceſs. Hence likewiſe we learn, that fix'd alcaline Salts, being mix'd with our Humours, will immediately render them acrid, alcaline, very active, more volatile than our Water, or our Spirits themſelves, and will communicate to them a corroding, cauſtic Quality, and very ſoon reduce them to a ſtate of Putrefaction. If the Salt and ſaline Spirit, produc'd in this manner, are diſtill'd again ſome number of times with a gentle Fire, they become as purely alcaline as the Salt and Spirit prepar'd from Hartſhorn, and other more valuable Subſtances. If they are mix'd with Acids, they cauſe a moſt violent efferveſcence, particularly, if they are ſhaken together; and they are by this means ſo qualified, that they continue no longer acrid, ſo alter'd, that they are no more alcaline or cauſtic, and ſo fix'd, that they will not fly off with the heat of the human Body; and thus they loſe the power of acting proper to volatile Alcali's, that particularly of diſſolving our Humours with an almoſt fatal ſolution. But in the laſt place, which moſt nearly concerns us, hence the Phyſician may underſtand the changes of our Salts from their natural diſpoſition, to various others, together with their proper effects under every alteration, and the Remedies that are ſuited for the correcting every *Species*, and all the degrees of it. This the ancient Phyſicians from careful Obſervations were well acquainted with. Hence in Fevers, with a great degree of heat and motion, *Hippocrates* allow'd nothing, either for Food, Drink, or Medicine, but thoſe things that were aceſcent, or actually acid. And certainly fix'd Alcali's prove deſtructive to our Bodies, when there is too much heat and motion in 'em, the Urine ſmells ſtrong, is high-colour'd, and is diſcharg'd in too ſmall a quantity, and the *Craſis* of the Blood is broken: Hence in the Plague the uſe of theſe Salts is particularly fatal.

PROCESS XCVII.

Quick-Lime being mix'd with freſh healthy Urine, eſpecially when it is inſpiſſated, communicates a fiery Spirit to it, not an alcaline one.

APPARATUS.

IF you throw Quick-Lime into very freſh Urine, there inſtantly exhales a Vapour which affects the Noſe with a kind of fiery pungency; and if you then immediately diſtill it in Veſſels accurately clos'd, you have a very limpid Water, of an intolerable fiery ſmell, like the former, but much more acrid and volatile. But if you firſt inſpiſſate the Urine to one fortieth part, and with this *Reſiduum* mix an equal quantity of Quick-Lime, then the ſmell that riſes will be much ſtronger, and by diſtillation you will procure a Spirit to which there is no other comparable, whether you conſider its igneous acrimony, or its incoercible volatility. If after you have according to Art drawn off all this Spirit, you commit it to diſtillation again, you will never be able to procure a ſolid Salt from it, as in the preceding Proceſs, but will conſtantly find it very liquid. And mix it with what Acid you will, it never cauſes the leaſt efferveſcence; though at the ſame time, by its combination with Acids it loſes a great deal both of its fiery quality, and volatility. But let me caution you, that ſome care is neceſſary in this Operation; for as ſoon as ever the Quick-Lime comes to touch either the natural or inſpiſſated Urine, there is inſtantly excited a prodigious Ebullition and Heat, and at the ſame time there is produc'd an exceeding acrid Spirit, and the moſt volatile of all that we know of, which being agitated by the violent Heat, rages furiouſly, and is put into a moſt rapid Motion, ſo that if a Perſon ſhou'd unwarily receive it into his Lungs, it might in a moment prove of the moſt dangerous conſequence, by cauſing a ſudden Inflammation in the tender Veſſels, and being directly applied to the vital Blood as it paſſes through the Lungs. For if this Spirit is kept applied to the Skin of a warm Body, which is hard in compariſon of thoſe Veſſels, it will inſtantly produce a Gangrene there, fatal to the Part. What then muſt be the conſequence in the Lungs, where the thickneſs between the pulmonary Blood and the Air in the Veſicles is not, perhaps, the thouſandth part of an inch? If this urinous Spirit, however, prepar'd with Quick-Lime, is expos'd to the open Air, it ſoon loſes this acrimonious part, a watery kind of Liquid remaining behind.

USE.

HENCE we learn the action of Quick-Lime upon the ſaline and urinous Humours of the human Body; for by means of the vital Motion and Heat of it, it immediately produces ſuch fiery Spirits as have been deſcrib'd, which prove fatal to the tender Pulp of the Brain and Nerves. And the hotter the Body is, or the more it is in motion, or is affected with a more burning Diſorder, the more deſtructive is the uſe of it. But when, on the other hand, the Body abounds with acid or watery Humours, or a ſoft pituitous Matter, the prudent adminiſtration of it may be attended with more ſucceſs. But we may obſerve that a *Lixivium* of Quick-Lime is particularly efficacious in correcting and extricating the more fix'd, muriatic Salts, and diſpoſing them to paſs more eaſily out of the Body. And hence this proves a ſingular Remedy in that kind of Scurvy, which ariſes chiefly from theſe Salts; though in that ſort which proceeds from a putrid cauſe, and conſiſts in an acrid Oil and Salt, it does a great deal of harm. From which conſideration, perhaps, one may in ſome meaſure account for the very ill ſucceſs, which ſome famous *French* Phyſicians tell us they obſerved of a *Lixivium* of Lime in *France*, whereas in *Germany* they had ſeen it have excellent Effects. All theſe things, now, are in a greater degree true of Lime made of Stones, than of that made of Oyſter-ſhells. From what has been ſaid then, give me leave to deduce the following Corollaries.

1. The violent Corroſion that happens to a human Body from the application of Quick-Lime to it, depends more upon the igneous ſaline Spirits which the Lime produces from a Salt that was not acrid before, than upon any corroſive Quality of the Lime itſelf.

2. Hence in acid, aqueous, auſtere, ſlow, mucous, and pituitous Diſorders, where there wants both Motion and a *Stimulus*, it may be of ſervice.
3. But in alcaleſcent, bilious, ſaline, hot, acute, and dry ones, and where the *Craſis* of the Blood is broken, and there is ſome degree of Acrimony, there it does miſchief.
4. The ſoft Salts of the human Body may, by being ſimply mix'd with a Subſtance not acrid, in a moment become exceeding acrid, fiery, and poiſonous.
5. Something vaſtly acrid may be generated from a ſound Humour, which ſhall be neither Salt, Spirit, nor Oil; for this Liquor can by no Art that I am acquainted with be brought to appear in the form of a ſolid Salt, but when it is ſeparated from all its Water, it becomes inviſible.
6. Theſe Spirits, which by no Experiments with Acids appear to be alcaline, are much more acrid than any Alcali. Nor is there any other known Spirit that gives out more of a very acrid ſtrong Vapour that ſtings the Noſe. Hence then we ſee, how very ſoon, from our Salt which is almoſt inodorous, a Smell and Taſte may be excited of quite a different nature.

PROCESS XCVIII.

The Native Salt of Urine.

APPARATUS.

TAKE ſome very freſh well-concocted Urine of perſons in perfect Health, put it preſently into a very clean Veſſel, and with an equable Heat of 200 degrees, evaporate it till you have reduc'd it to the conſiſtence of freſh Cream, and whilſt it continues thus hot ſtrain it through a Bag, that the tenacious Oil may in ſome meaſure be retain'd there, and ſeparated from it; and the more accurately this is done, the better. Put a large quantity of this thick inſpiſſated Liquor into a tall cylindrical glaſs Veſſel, with a paper tied over it, and let it ſtand quiet in a cool place for the ſpace of a Year. By this means, then, you will have a ſolid, hard, ſub-pellucid, brown, ſaline Maſs, fix'd all about the bottom of the Veſſel; and over this a thick, black, pinguious Liquid, ſeparated and rejected as it were from the concreted Salt. Decant this Liquor, take out the ſaline Maſs, put it into another Veſſel, pour ſome very cold Water upon it, and ſhake it about to free it from its oily Impurities, which may be done pretty eaſily, as it will not readily diſſolve in cold Water. Keep this ſaline Matter under its proper title. If this is diſſolved in hot Water, and ſtrained till the *Lixivium* becomes exceeding limpid, and evaporated to a Pellicle in a very clean glaſs Veſſel, then, if you ſet it by in a cold place, it will ſhoot into ſaline Glebes of a particular kind, that are perfectly diſtinct from every other Salt. In their figure, and ſolidity, however, they come pretty near to the Cryſtals of Sugar. Theſe are not fetid, nor alcaline, but very volatile. This is the native Salt of Urine.

USE.

THE Chemical Art, by the production of this Salt, elegantly teaches us the nature of thoſe Salts, which, in a healthy Body, are the moſt acrid, and alcaleſcent, though not yet alcaline, and which therefore are now to be expell'd out of the Body by the ſame vital powers, to which they owe their origin. The Phyſician, therefore, hence underſtands, that the Salts that are contained in the other Humours are much leſs acrid, or alcaline. Theſe Salts are generated by the human Nature from the Meat, Drink, and Sea-Salt taken into the Body. Nay there is a true Sea-Salt here, but not alone. This Salt is ſaponacious, but not very pinguious. If it is diluted with Water, and drank, it proves a great diuretic; and with a proper Regimen it eaſily provokes Sweat. Upon Metals it has ſuch a wonderful effect, that ſome Perſons have promis'd themſelves ſtrange things from it. The pinguious Matter that remains in the inſpiſſated Urine, after all this Salt is form'd and ſeparated from it, is excellent for making Phoſphorus with, and therefore it may be ſav'd for that purpoſe. By this Experiment then we ſee, that the Salts that reſide in this inſpiſſated Urine, do not grow ſo putrid, or alcalious, as to become volatile, and readily fly off, tho' in other reſpects they are ſo eaſily alter'd. How is this Salt concern'd in the human Calculus?

PROCESS XCIX.

Milk, being digeſted, caſts up a Cream, and grows acid.

APPARATUS.

1. I PUT ſome new Cow's Milk into a large cylindrical Glaſs, and ſet it by in a cool place, cover'd only with Paper. In a ſhort time, then, there is a very white, thick, oily, ſoft Fluid, collected at top, which is neither acid nor alcaline, and is call'd Cream. I take this off carefully, and put it into another clean Veſſel. Soon after this, there is a new Cream form'd upon the remaining Milk, but in leſs quantity than before, which I take off likewiſe, and add to the former, and proceed in this manner till there is no appearance of any more. What then remains is call'd Skim-milk, and is thin, pretty clear, and bluiſh. This Cream, of all Balſams, is the moſt excellent, uſed, either internally or externally. It is friendly to the human Body, and ſoftens all kinds of Acrimony, and hence in conſumptive, nephritic, and gouty caſes it yields the greateſt relief, and is of excellent ſervice applied to a Wound, or a painful Ulcer. And the Skim-milk too being now freed from its Oil, is an incomparable Medicine in acrid Diſorders of fat, and bilious Conſtitutions. Hence it appears, that there is a great Similarity betwixt Milk and the vegetable Emulſions of Proceſs 21, though there is ſome difference, ariſing from the animal Humours the Milk is mix'd with, and the Heat it is expos'd to.

2. If Milk ſtands quiet in a pure Air, free from fetid and putrid Exhalations, and about 60 or more degrees warm, it begins to grow ſour, and afterwards perfectly acid, its Acidity gradually increaſing till it riſes to a pretty

conſiderable degree. Then the whole Milk, both the Cream, and the thinner part underneath, are become acid; as the Smell, Taſte, Acrimony, and other qualities demonſtrate.

3. If you ſeparate the Cream carefully whilſt it is freſh, and ſet it by in the ſame manner, that grows acid likewiſe, and pretty much ſo; and then it ſupplies us with a Balſam, which, both for internal and external uſe, is exceeded by none, in hot, putrid, bilious Caſes. All theſe things, now, happen ſooner, and riſe to a greater degree in hot weather, than cold; in the Milk of an Animal that feeds upon Graſs, than of one that lives upon Hay; and in that of one that is exerciſed but little, than of one that is uſed to a great deal.

4. If the Milk is taken from an Animal, that is of too hot a temperament, whoſe Body has been heated with very hard labour, which has liv'd upon animal Foods in particular, or alcaleſcent Vegetables, with very hot Sauces, and drink not ſtale, or whoſe Humours have been roaſted, as it were, with a burning Fever, or diſſolv'd by a putrid Conſumption: I ſay, if ſuch Milk is treated in the ſame manner, it grows fetidiſh, with a kind of urinous Smell, or one like that of Sweat, of a yellowiſh Colour, thin, and reſolved as it were, and is of a ſalt, diſagreeable Taſte, not a ſweet one: And if it is digeſted, it does not then grow acid, but acquires an unpleaſant Smell like that of rancid Cheeſe, and inclines to be alcaleſcent. Hence Children abominate ſuch Milk, and as ſoon as ever they taſte it, cry and leave it, tho' they take it again greedily, when it comes to be good.

USE.

THIS Experiment, I think, is one of thoſe, which under a ſimple appearance contain a great many uſeful things for the information of the Chemiſt, and ſervice of the Phyſician, and which are neceſſary to be known by them both. Hence it appears, that there is a greater quantity of Oil in the Milk than in any other Humour of the human Body, tho' at the ſame time it more eaſily recedes from the watery part in this, than in the other Humours: That Milk therefore contains a little Salt, not well work'd together, and united with the Oil, for which reaſon it differs greatly from a Soap conſiſting of an Oil and Salt combin'd together; and that Oil, conſequently, is very ſlowly divided and intimately mix'd with the other Humours, which makes it ſeparate ſo often, and ſo eaſily in the Body, and collect itſelf in the adipoſe and medullary Cells appointed for its reception, in which, however, it may be diſſolved again by Heat and Motion, and ſo return into the Veins, mix with the acrid ſaline Particles, and by this means, at laſt paſs out of the Body, in form of a fetid, greaſy, yellow Sweat, or a high-coloured, putrid, and very acrid Urine. But here we learn, likewiſe, that this Oil in vegetable Milk, retains a good while in the Body an aceſcent diſpoſition, and may ſometimes be converted into an Acid; and that all aceſcent milky Aliments from Animals, or Vegetables, enjoy their proper Nature for ſome hours there, and operate by it. But if the vital Powers, a great degree of Heat, the abſence of an Acid, and a putrid ſtate of the Air act upon this Cream, or Milk, then the Cream loſing its aceſcent Nature, may grow bitter, rancid, and alcalious, as was obſerved before in Tartar. We muſt not, therefore, without a great deal of caution, pretend to pronounce concerning the animal Humours; for the Milk lodg'd in the Breaſts of a Woman in a Fever, may acquire ſuch an acrid rancidity, and produce ſurprizing diſorders as daily Obſervation ſufficiently evinces. And why mayn't the ſame thing happen to the Milk, whilſt it circulates mix'd with the Blood? The Oil of Milk then may grow acid, bitter, rancid, and at laſt putrid; its cheeſy part is diſpoſed to become rancid, putrid, very acrid, and alcaleſcent; whilſt its wheyey part grows acid chiefly, and ſeldom undergoes any other alteration.

PROCESS C.

Urine, by being digeſted, grows alcalious, and is altered in its Colour, Smell, Taſte, and Powers.

APPARATUS.

IF ſuch Urine, as is deſcribed in Proceſs 92, ſtands in an Air 33 degrees warm, in glaſs, wooden, earthen, or metal open Veſſels, it in a little time begins to grow ſtrong, and putrid, to have its Colour changed from a citron to a dark brown, to depoſite thick *Fæces*, and thus in a few days to acquire an alcaline, lixivious diſpoſition, and in the mean time to fix an alcalious Cruſt on the whole ſurface of the Veſſel. And in proportion, as the Heat of the Air increaſes, the more conſiderable and ſpeedy is this Alteration, ſo that in the hotteſt Summer weather, theſe *Phænomena* appear moſt remarkable. In order now to diſcover how far this mutability would reach, I took ſome very freſh Urine, fill'd a Bottle with it, cork'd it up, and ſet it by in this condition in a place of a middle temperature, and after three months I found the Urine was ſpontaneouſly chang'd in the manner juſt mention'd. This alteration now conſiſts principally in the following circumſtances. In the firſt place, the freſh Urine of a healthy Perſon is of a citron Colour; the digeſted is of a deep brown inclining to black, the former changing gradually every day, till by ſucceſſive degrees, it has acquired this dark one, ſo that it grows proportionably deeper, as the Urine becomes more putrid. And this the Phyſicians obſerve in the Urine in Fevers, and hence from the Colour of it ſafely conclude concerning the condition of the Humours. But then again, freſh Urine has a diſagreeable Smell, but not an alcaline one; digeſted, ſends forth an evident fetid, volatile, alcaline one, very different from the former. The Taſte too of freſh Urine is bitter, and ſalt; that of digeſted, putrid, acrid, alcaline, and perfectly lixivious. Nor does freſh Urine by any mark diſcover the preſence of any Alcali in it; but digeſted, as you here ſee, cauſes an Ebullition and Effervеſcence with every Acid that is mix'd with it, and by every quality makes appear a true alcaline Nature. And laſtly, freſh Urine has not a deterging ſaponacious quality; but that which is digeſted and putrified, is uſed by the Fullers and Dyers as the ſharpeſt Lye they can get to ſcour their Wool, Silk, and other Bodies; but this Power belongs properly to fix'd Alcali's. As I have certainly found now, that this happens in a ſmall degree of Heat, and in a cloſe Veſſel, and every Body may be ſatisfied of the ſame without any trouble, it's idle to deny Urine to have ſuch a diſpoſition, as ſome Perſons verſed in the Chemical Art have done.

USE.

A Watery Fluid then, containing thoſe Salts and Oils which are the neareſt to a ſtate of Putrefaction, is ſeparated by the urinary paſſages, and ſo diſcharged out of the Body; for we do not find any other Humour, which is altered ſo ſoon, and with ſuch a digeſtion, nay even in a cloſe Veſſel. The Urine therefore which is deſigned for excretion, purges the Blood from thoſe putrid Particles, which would otherwiſe prove injurious. If it happens therefore to be retain'd in the Body by any Diſeaſe, it brings on fatal conſequences, being by the heat of the Body ſoon render'd more acrid, and hence in a ſhort time growing intolerable to the very fine Veſſels, and cauſing a deſtructive ſolution of the Humours. As Urine now acquires theſe new qualities ſo eaſily, ſo ſoon, in a moderate degree of Heat, and in a cloſe Veſſel, hence we learn, that the human Nature does not generate Vinegars, or inflammable Spirits from the Subſtances received into the Body, and conſequently does not act by Fermentation, but cauſes the ſame alterations that Putrefaction does, and therefore in its effect, comes neareſt to that. *See Proceſs* 88. For if the ſole ſtagnation of Urine changes it in this manner, how very prone is it to Putrefaction? How neceſſary, therefore, are Water, Acids, aceſcent Subſtances, and Saline ones, to thoſe Perſons who live in hot Climates, or are daily exerciſed with hard Labour? For by Meats, Drinks, and Sauces, of this kind, too great a diſpoſition to Putrefaction is prevented. Hence too ariſes a daily neceſſity of a ſupply of a ſoft, aceſcent, new Chyle, to ſheath and ſoften the acrimonious Particles produced in the Blood. But it is farther evident, that the beneficial qualities of this new Chyle, do not remain for the ſpace of four and twenty hours, and conſequently that a freſh recruit from the ſame kind of Bodies becomes neceſſary within that time: In the moſt burning Fevers, therefore, there is the greateſt neceſſity of acidiſh, watery, ſoft Aliments, as like as poſſible to the Chyle, too great abſtinence in theſe caſes being highly prejudicial. Hence Ptiſans made of Barley, and mix'd with *Oxymel*, are of ſuch excellent ſervice here, as *Hippocrates* wiſely inculcates in that incomparable Book *De Victu Acutorum*. But the Phyſician, likewiſe, in examining the Urine of his Patients, may be greatly aſſiſted by theſe Experiments, as by theſe he will be able to diſcover the alterations of the Oil, and the Salt. Hence too he underſtands that a true Stone may be generated from the Urine of the moſt healthy Perſon, only by its ſtanding quiet, even whilſt it putrifies, and grows alcalious; and conſequently, that neither Attenuation, an Alcali, or Putrefaction, will prevent the breeding of a Stone, ſince this will be form'd even in putrified Urine, and will not afterwards be diſſolved in it. Hence, therefore, as Tartar is generated from the beſt Wine, ſo a Stone is produc'd from Urine thoroughly concocted by the vital Powers, without a future reſolution. In vain therefore ſhall we drink volatile alcaline Salts to prevent the Stone. I fill'd once a very clean glaſs Bottle with the Urine of an healthy Perſon, and ſtopt it, and ſet it by. When the Urine was putrified, I poured it out, in order to diſtill it, and was ſhock'd to ſee how the inſide of the Bottle was covered with a ſtony Cruſt: Without waſhing this off, I put in ſome more freſh Urine, and after it had ſtood a pretty while, poured it out as before, and when this had been repeated ſome number of times, the internal ſurface was perfectly incruſtated over with a calculous Matter. How pernicious to the human Body is the generation of ſuch a Matter? But ſtill it is neceſſary. Perhaps ſome Perſons now may be ready to ſay, why then don't the human Body itſelf putrify by its vital Heat and Motion, ſince it renders the ſoundeſt Humours putrid in ſo ſhort a ſpace of time, and dead Bodies, by being expoſed in the open Air to a Heat of 80 degrees, diſſolve with Putrefaction in a few hours, and becoming volatile are diſſipated into the Air, their Bones only being left behind? Why to this the prudent Chemiſt will anſwer, that ſuch a Putrefaction, which would otherwiſe certainly happen, is prevented by the Air, and thoſe ſorts of Drink, Food, Sauces, and occaſionally Medicines too, that reſiſt ſuch a kind of Corruption; for otherwiſe, in burning Fevers the whole Frame would ſoon be diſſolved by Putrefaction.

PROCESS CI.

Urine digeſted and then diſtill'd, yields alcaline Spirits, a very fetid Oil, a volatile, alcaline, oily Salt, Phoſphorus, and Sea-Salt.

APPARATUS.

IF Urine digeſted according to the preceding Proceſs, is diſtilled in a glaſs Cucurbit with a gentle Fire, there firſt riſes a Liquor that diſcovers itſelf by *Striæ* running down like thoſe of Spirits. When this is drawn off, and you fix on a freſh Receiver, and make your Fire a little ſtronger, there follow dewy drops like thoſe of Water, which will continue to be ſeparated till the remaining Matter becomes almoſt dry. This, however, if it is urg'd with a very great degree of Fire, will give out a yellow, and very fetid Oil, with which there will at the ſame time riſe ſomewhat of a Salt. There will then remain ſome black *Fæces*, which by the help of Water may be reſolv'd into Sea-Salt, and a fine, fix'd, inſipid Earth. The firſt Water now, is fetid, acrid, igneous, perfectly alcaline, and with Acids cauſes a moſt violent Effervеſcence: If this is expoſed to a gentle Fire, in a tall Veſſel, it will yield a white, acrid, ſolid, and perfectly alcaline Salt, and at the bottom there will be left a Water of a very diſagreeable Smell and Taſte. If the ſecond Water is diſtill'd for a good while in a tall Veſſel, and with a gentle Heat, it will yield ſomewhat of the former Spirit. When this is accurately drawn off, if you diſtill the remaining Water in a clean Veſſel, you will have a Liquor, which the great *Van Helmont*, in his Treatiſe *De Lithiaſi*, extolls as the nobleſt Lithontriptic. In this Operation there is no appearance of a fix'd alcaline Salt, but a true Sea-Salt, if the Perſon whoſe Urine you thus examine, uſed it pretty freely. In order now to procure a conſiderable quantity of this volatile Salt, I have often proceeded in the following manner. I take a hundred Pounds of the Urine of healthy Perſons, and putting it into a large, low Veſſel that grows wider upwards, boil it till it is inſpiſſated to about the thickneſs of Honey, taking care that none of the pinguious Matter runs over, and is loſt. When I have got a good quantity of this, I pour it into an open cylindrical Glaſs, and ſet it in a warm place in a Granary for ſome months, that this pinguious fetid Matter may grow thoroughly putrid. I then put it into an iron Pot, to which I can lute on very cloſe a large earthen Alembic, and to the long Beak of this I apply one of the largeſt Receivers. This being done, I gradually raiſe a Fire under it, and there aſcends an incredible quantity of a white alcaline Salt, and then a yellow Oil which renders the former Salt impure, and with this another Salt ſomewhat more fixed than the other. I then urge the *Reſiduum* till the Pot begins to grow red hot, and then comes off an Oil, and the laſt Salt. The iron Pot being a little cool'd, but the fix'd Matter ſtill remaining very hot, I remove the Receiver, and keep all that is come off ſtopt very cloſe in glaſs Veſſels, which may be reſolved into a Spirit, Salt, and Oils, as before. If you then mix the *Caput Mortuum* that remains with twice or three times as much Charcoal and put the Compound into ſmall coated earthen Retorts, diſpoſed in ſuch a manner that the Mouths of them ſhall lie under Water in their Receivers, then if you urge it for the ſpace of ſixteen hours with the ſtrongeſt Fire, it will at laſt give out ſome bluiſh Corpuſcles, which fall to the bottom of the Water, and lie collected under it. And if you then ſet the Receiver upon the Fire, and make it very hot, the Matter of the Phoſphorus will not diſſolve in the hot Water, but will melt like Wax, and run into one Maſs, which will retain its Properties for twenty years, or longer, if it is kept under Water. See *Boyle's Noctiluc. Aer. Act. Lipſ.* 1683. p. 457. *Homberg. Mem. Math. & Phyſiq.* 1692. p. 74. to 80. *Nieuwentyd.* p. 520. *Hoffman Diſſert. Phyſ. Chem.* 336. Or if you take part of the fixed Matter that remains in the Pot, and reduce it by an open Fire to a white *Calx*, and then mix it with clean Water, it will communicate a Salt to it, which being ſeparated and collected together, will give you a true Sea-Salt, which has remained ſuch, after having undergone all the digeſtions of the Body, ſo long a Putrefaction, and ſuch a violent Diſtillation. That it is really now true Sea-Salt appears by its Taſte, but particularly by this property of it, that if it is mix'd with *Aqua Fortis*, it will diſſolve Gold. Nor is there any fixed alcaline Salt at all found here, every thing ſaline being either volatile, or Sea-Salt.

USE.

THIS then is the true *Analyſis* of Urine after it is putrified. It yields intirely the ſame things as freſh Urine diſtill'd does, but with a leſs degree of Heat, and in a different order. The Putrefaction rendered the Salts more volatile than Water, and from non-alcaline, made them alcaline. The Oils it rendered more acrid, fetid, and volatile. It generated, however, no inflammable Spirits, nothing of a fixed or volatile Acid, nor any thing of a fix'd alcaline Salt. There are two Salts here, however, that differ in degree of volatility, the firſt of which riſes ſoon and eaſily, and is ſeparated almoſt pure, whilſt the other comes off later, and with more difficulty, ſome of it with a great, and ſome with the greateſt degree of Fire, and is mix'd with a good deal of Oil that is not eaſily ſeparated from it. And indeed, when I have been urging the *Fæces* of Urine, prepared in the manner abovemention'd, with the intenſeſt Fire in the Preparation of Phoſphorus, I have been ſurprized to ſee how long the Salts wou'd ſtill riſe, notwithſtanding they had been ſo long expoſed already to the violence of the former Fire. But what a thick, yellow, fetid Salt remain'd here fix'd to the Neck of the Retort? All Acids, then, are by the vital Powers converted into a neutral Salt. But this neutral Salt is chang'd by Putrefaction into a true alcaline one, and by this means acquires the greateſt degree of volatility we know of, it being more volatile, not only than Water, but even Alcohol itſelf. This renders volatile all the Salts both of Animals and Vegetables, but Sea-Salt, *Sal-Gem*, and Fountain-Salt, it is neither able to volatilize, nor turn into an Alcali. Some of the greateſt Maſters of the Art, indeed, even in our days, have aſſerted, that an Acid, by an extreme Fire, may be forced out of the *Caput Mortuum* that remains after the Diſtillation of Urine. And this I have found true, when a conſiderable quantity of Sea-Salt, that was taken in with the Food, was contained in theſe *Fæces*; for this, as I mentioned before, remaining unaltered, if it is mixed with a good deal of Earth, will by the torture of the Fire exhale an Acid of Sea-Salt, which has too haſtily been look'd upon as an Acid truly prepared from the Animal Humours. Tho' this is my Opinion, I muſt however allow, that in Phoſphorus ſpontaneouſly diſſolv'd in the Air, there is an Acid not very different from Oil of Vitriol, or burnt Sulphur. *Homberg, Mem. de l'Ac. Roy. des Sc.* 1706. p. 340. And hence with Mercury it makes a kind of compound Body. *Id. Mem. de Mathem. & Phyſic.* 1692. p. 80. But whence now comes this Acid? For my part, I confeſs I am ignorant. Certainly it is like none, either in the Animal, or Vegetable Kingdom. Was not there Alum uſed in making the Phoſphorus? This is the beſt way of preparing it, and its Oil is exceeding like that of Vitriol. In the mean time it is certain from other Experiments, that Fowls kept up in a Coop, and living only upon aceſcent Meat, and Water, upon being burnt together with their Dung in an open Fire, yielded *Fæces* in which there was not the leaſt acid, or fix'd Alcali. If the Spirit of this Proceſs, which is highly ſaturated with a volatile alcaline Salt, is rectified, it becomes exceeding limpid, but by keeping, grows brown, and gradually depoſites ſomething earthy, as it were, on the ſides and bottom of the Veſſel. Is this that volatile Earth that riſes with the firſt Spirit of putrified Urine, and fixes ſuch a Cloud upon the Glaſs as can't be wiped off, but which ſpontaneouſly diſſolves with the following Spirit, which is ſcarcely ſaline; concerning which, *Helmont* talks ſo much in that noble Book *De Lithiaſi?* You may think of this and try it: The thing is eaſy enough, nor is it without its uſe. Alcali's now, in their Nature, rather tend to generate Stones than otherwiſe; if this ſecond Spirit, therefore, which is not alcaline diſſolves them; then in the Urine there is contained both the Matter they are form'd of, and its Solvent. Sea-Salt, therefore, does not produce Stones in the human Body, but diſſolves them rather, and prevents them, as by its ſaltneſs it preſerves the Humours from growing putrid, and alcaleſcent. Hence Vinegar, Sea-Salt, and Sulphur, with a *Vinum Picatum*, were looked upon by *Van Helmont*, as the chief anti-peſtilential Medicines of *Hippocrates* in that moſt putrid of all Fevers, the Plague. And for this reaſon, the Adepts cry out, that *in ſale & ſole* Nature has placed abſolute Perfection. When a Stone is formed, however, from the Urine, it cannot be eaſily reſolved, any more than thoſe ſtony concretions can, that are generated in the Gout.

PROCESS CII.

The Origin of Sal-Ammoniac.

APPARATUS.

THE modern *Sal-Ammoniac* is brought chiefly by the Merchants from *Egypt*. It is almoſt pellucid in the middle, lying in long parallel *Striæ*, being black at bottom, and formed into pretty thick large Cakes that are plain at top, and ſpherical underneath. It ſcarcely diffuſes any Smell, when you examine the pure middle part of it. It has a taſte like Sea-Salt, but much more penetrating. In the open Air, it ſpontaneouſly, and ſoon diſſolves into a very limpid ſalt Brine. A Salt ſo exceeding like this, I have prepared myſelf from Soot (*Proceſs* 86. *Apparat. No.* 6. *Uſe No.* 6.) that it cou'd ſcarcely be diſtinguiſh'd from it. And this they make now-a-days with inſpiſſated Urine, of thoſe Animals to chuſe which drink but little, as Camels 10 parts, Sea-Salt 2 parts, and the beſt wood Soot 1 part. Theſe they mix together, boil in Water, filter, dry, ſublime in proper Veſſels, and then diſſolve again, depurate, and coagulate. *Ol. Worm. Muſ.* p. 20. *Cæſius de Foſſilibus*. This Salt therefore is produc'd by both theſe Methods.

USE.

THE Origin, therefore, of *Sal-Ammoniac*, is pretty ſurpriſing. The ancient *Sal-Cyrenaicus*, or *Ammoniacus*, was produc'd from the Urine of Camels in *Lybia*, where they principally make uſe of them, which ſinking in large quantities into the Sand, was dry'd, and ſublimed by the exceſſive heat of it into a Salt. Some of this ſort the famous *Tournefort* gave *Pomet*, which was very different from the common *Sal-Ammoniac* of the Moderns. See *Pomet de Drogues*, and compare what he ſays with *Pliny*, XXXI. 7. and *Dioſcorides*. This now ſhould ſeem to be purely animal. But there is another ſort, ſaid to be produced and gathered in the hot Countries about the burning Mountains, which one would think ſhould be of the ſooty kind. *Mem. de l'Ac. Roy. des Sc.* 1705. *Hiſt.* 83. From Soot I have made it myſelf. But that compound one, mentioned above, muſt conſiſt of an animal, vegetable, and foſſil Matter compounded together. For Urine ſpontaneouſly putrifies into an alcaline Salt, this the Sea-Salt overpowers, fixes, and converts into *Sal-Ammoniac*, and the vegetable Soot ſupplies the ſame. This Salt, now, is as ſurprizing in its Properties, as it is in its origin. If it is diſſolved in Water, filter'd, and inſpiſſated to a Pellicle, it ſhoots into Cryſtals that are exceeding ſubtil, like Down, and as white as Snow. If theſe are dried, and are carefully ſecured from all moiſture, upon being mixed with Water they produce a greater degree of Cold, the inſtant of Solution, than can be excited in any other way we are yet acquainted with. It beautifully preſerves all animal Subſtances from Putrefaction, and its Brine penetrates into the moſt intimate parts, and is the nobleſt aperient, attenuant, reſolvent, ſtimulant, errhine, ſternutatory, diaphoretic, ſudorific, antiſeptic, and diuretic.

PROCESS CIII.

Sal-Ammoniac *is neither acid, nor alcaline.*

APPARATUS.

IN this clean Glaſs I have ſome very pure *Sal-Ammoniac*, diſſolved in 3 times its weight of Water, filter'd into a very limpid Brine, and then heated to a 100 degrees. Into different Portions of this, now, I pour ſucceſſively Vinegar, Spirit of Nitre, and Spirit of Sea-Salt, and there does not, as you obſerve, appear the leaſt ſign of any Effervеſcence, nor does the Liquor grow turbid. In the *Sal-Ammoniac*, therefore, in this reſpect, there is no Alcali. Upon pouring in Oil of Vitriol, indeed, there does ariſe ſome Fume, and ſome degree of Motion, but this is owing to another Property of it, which will be more conveniently explain'd hereafter, *Proceſs* 106, 107. but more particularly 143; for whilſt the Oil of Vitriol lays hold on the latent Alcali of the Salt, it renders the acid Spirit of the Sea-Salt volatile. Upon the ſame Brine, in another Veſſel, I here pour a fix'd Alcali, and there is no Effervеſcence excited, but there immediately ariſes from it a very penetrating, volatile, alcaline Smell. This Salt, therefore, is of ſuch a nature, as is mention'd in the Title of this Proceſs.

USE.

IN this, therefore, *Sal-Ammoniac* agrees with the Salt of our Humours, that it cauſes no Effervеſcence, either with an Acid, or an Alcali, tho' upon the affuſion of a fix'd Alcali, it preſently gives out its volatile alcaline part, with a very pungent Smell. Nor does this Salt act in the human Body, or any where elſe with an Acid, or alcaline Vertue, but with the more penetrating one of common Salt. That this is the caſe, appears by all its Effects, but by this in particular, that if *Sal-Ammoniac* is mixed either with Spirit of Nitre, or *Aqua Fortis*, it will communicate to it a power of diſſolving Gold, or convert it into *Aqua Regia*, which nothing can effect but Fountain-Salt, *Sal-Gem*, and Sea-Salt: In this reſpect, therefore, it is a ſemi-volatile Sea-Salt.

PROCESS CIV.

Sal-Ammoniac *ſublimed into Flowers.*

APPARATUS.

TAKE ſome *Sal-Ammoniac*, reduce it to Powder, dry it, and put a pound of it into a Cucurbit made of *Heſſian* Earth, and almoſt of a cylindrical Figure. Fix on a very large Head, and cloſe the Joints with Clay and Sand work'd together in equal quantities. Place 'em then in a ſand Furnace in ſuch a manner, that the Beak of the Alembic may decline a little downwards, that if any Water ſhould come off firſt, it may run out of the Head into a Bottle applied to the Beak. Let the Cucurbit be covered with Sand, almoſt to the loweſt Limb of the Head, and let there be raiſed under it a Heat of 150 degrees, to be continued till all the Moiſture is diſtill'd into the Bottle. Then changing the Bottle gradually increaſe the Fire till the Alembic begins to be clouded with a very white Snow, and keep it up in that degree, without letting it ſlacken, for the ſpace of eight or ten hours. Let all grow cold, remove the Sand, and take out the Cucurbit and Alembic very gently, leſt the Salt in the Alembic ſhould be ſhaken out. Lay the Cucurbit in a horizontal poſition upon a Table, with a Knife take the Lute clean off, wipe off the Sand, Duſt, and Lute from the Cucurbit and Alembic, and then whilſt they continue in this ſituation, very gently draw off the Alembic, and it will be full of a fine, light, ſublimed, ſnowy Salt, of which too there will be a good deal upon the upper rim of the Cucurbit. All this Salt being removed, and put into a very dry, clean, hot Glaſs, with a wide Mouth, you will find about the upper part of the Cucurbit, a white, thick, denſe, compact Cruſt of the ſame Salt, but which did not aſcend into the cavity of the Head, but ſtopp'd and fix'd here. Take this off with the ſharp Edge of a Knife, and put it into a Bottle as before. Then very gently turn the Cucurbit upſide down over a clean Paper, and there will fall out a pretty deal of the firſt white Flowers, which dropped off in moving the Veſſels, and which if they are perfectly pure, may be added to the former. At the bottom of the Cucurbit, there will then appear a few black, ſaline *Fæces*, which may be ſhook out, but are of no great uſe, yielding only a bitter, black, fæculent Matter. When the firſt part is pure by itſelf, it is called the true Flowers of *Sal-Ammoniac*, the *Aquila alba Philoſophorum*, and the *Aquila Ganymedem in cælum Jovis rapiens in ſublime*. The other Salt which was at the upper part of the Cucurbit, goes by the name of ſublim'd, or rectified *Sal-Ammoniac*. If the Flowers, or ſublim'd Salt, are diſſolved in Water, they excite Cold, as I took notice before of the Salt itſelf. If you diſſolve them, heat the Solution, and mix Acids with it, there is no Efferveſcence produced, except upon pouring in Oil of Vitriol, as I obſerved concerning the Salt in the preceding Proceſs. Nor does it cauſe any Efferveſcence with a fixed Alcali, but immediately gives out ſuch a Vapour, as is there deſcribed likewiſe. If you repeat this Sublimation of *Sal-Ammoniac*, it gradually riſes with more and more difficulty, till it at laſt becomes almoſt fixed, tho' it ſtill retains its former qualities.

USE.

HERE then you have a Salt of the nature of Sea-Salt, but ſemi-volatile, for it is not ſo volatile as to riſe with the heat of boiling Water, nor yet ſo fixed as Sea-Salt. When it is thus purified, it loſes that clearneſs which I obſerved appeared in ſome meaſure in the common *Sal-Ammoniac*. By Sublimation it does not acquire an alcaline quality, in which particular it differs from Salt of Urine; but it remains juſt as it was, only of a more beautiful Colour. It has this wonderful property now, that whilſt it thus riſes dry in a cloſe Veſſel, it carries up with it almoſt all foſſil, vegetable, and animal Subſtances, and by this Sublimation ſurpriſingly attenuates them. Hence it comes to be called the *Piſtillum Chemicorum*, as the ſame attenuation can ſcarcely be accompliſhed by any other means. And if theſe are ſublimed with *Sal-Ammoniac*, a conſiderable number of times, they at laſt become fixed with it, and thus often give riſe to the moſt beautiful Medicines, as *Paracelſus* found in Colcothar, rendered very pure by Water, and then rubb'd with Sulphur and ſublimed with this Salt.

PROCESS CV.

Sal-Ammoniac, *with Quick-lime, yields a fiery Spirit like that of Proceſs 97.*

APPARATUS.

TAKE ſome very dry Flowers of *Sal-Ammoniac*, put 'em into a clean, hot, glaſs Cucurbit, and pour upon them an equal quantity of Lime reduced to Powder as expeditiouſly as poſſible, in a dry, hot, iron Mortar, taking care that the Flowers are well cover'd with the Lime. At the ſame time have by you a clean dry Alembic, properly fitted for this purpoſe, ſo that the fine exhaling Corpuſcles may be immediately confined: For the very moment that theſe two Bodies come to touch one another, tho' they were at reſt, and inodorous before, there inſtantly riſes a Vapour from them, than which perhaps there is not a more acrid, or violent one in nature; certainly, in both theſe qualities, it is ſuperior to that excited from Urine in the ſame manner, Proceſs 97. Fixing on the Alembic then, and luting it cloſe, diſtill this Mixture with a gentle ſand Heat into a Bottle applied to the Beak of the Alembic, and you will by this means have a very ſmall quantity of a Liquor which is the moſt volatile, and moſt acrid of any we know of, but which nevertheleſs, is not alcaline. If you then increaſe your Fire to a conſiderable degree, the *Sal-Ammoniac* will not be ſublim'd, but by means of the Lime the whole Mixture will become fix'd; nay, if it is then put into a Crucible, and urg'd with the ſtrongeſt Fire, it will not leave the Veſſel, and become volatile: But when it comes to be cold, if it is broke in the dark whilſt it continues dry, it will throw out a Light from it like Phoſporus. *Du Hamel, Hiſt. de l'Ac. Roy. des Sc.* p. 305, 306, 307, 308.

2. Or take ſome Quick-lime, put it into a large glaſs Cucurbit made a little warm, pour upon it a Brine, made with one third as much *Sal-Ammoniac* diſſolved in three times its weight of Water, fix on an Alembic immediately, lute it on as expeditiouſly as poſſible with a thick Lute made of Linſeed-flower, and apply a very large Receiver to be luted with the ſame, and there will be ſoon excited a Heat, and moſt violent Ebullition, by which means there will be diffuſed an incoercible Spirit, which wou'd burſt the Veſſels unleſs the Lute yielded to it a little, and gave way; for the *Impetus* of it is ſo great, that it blows, as it were, like a Wind through the Lute, and diſperſes a Smell all around, and at the ſame time a Liquor diſtills into the Receiver, and in a very ſhort time is collected there in great quantity. After this ſpontaneous Heat of the Mixture is abated, let the Veſſels be luted cloſer, raiſe a little Fire under them, and gradually diſtill to a dryneſs. Let the Spirit then thus produced be ſtopp'd up very cloſe in a Bottle, and kept under its proper Title.

3. In the bottom there will remain a new and ſurprizing kind of Body, which being dried with a ſtrong Fire, appears almoſt of a glaſſy Nature, but gradually puffs up in the Air, tho' it does not diſſolve like *Sal-Ammoniac*, but is

reſolv'd into ſandy Grains, as has been taken notice of by one of the greateſt Maſters of the Chemical Art. See *Du Hamel*, in the place juſt cited, p. 408.

USE.

HERE then you have a farther agreement betwixt the proper Salt of the human Body, and *Sal-Ammoniac*; and here you ſee a Liquor produc'd from dry Bodies, and from inodorous ones too, that affects the Organs of Smelling more than any thing elſe. In this Operation too, you obſerve the generation of Spirits, which are vaſtly, nay ſpontaneouſly as it were, active, in the greateſt degree of Cold; and here you have a Spirit not alcaline, but vaſtly acrid, nay which in its Acrimony comes very near to Fire. It muſt be confeſs'd however, that if this Spirit, as it exhales through the Air, meets with a volatile Spirit of Nitre, it will with that produce white Fumes. This Proceſs, again, furniſhes you with a new *Species* of Phoſphorus, and here you ſee a fixation in ſome meaſure of *Sal-Ammoniac*.

PROCESS CVI.

Sal-Ammoniac, *diſtill'd with a fix'd Alcali, yields alcaline Spirits, and a volatile alcaline Salt.*

APPARATUS.

1. TAKE of the drieſt Flowers of *Sal-Ammoniac* 10 ounces, put 'em into a glaſs Retort, and pour upon them of the pureſt dry Salt of Tartar, reduc'd to a fine Powder, 3 ounces: Shake 'em well, that they may be thoroughly mix'd together, upon which there will riſe a very acrid, alcaline Vapour, for which reaſon you muſt immediately apply a large clean Receiver. Place the Retort in a Sand-Furnace, and gradually raiſe the Fire to the greateſt degree, and there will be ſublimed a very white, pure, ſimple, volatile, alcaline Salt, which being impatient of reſt, will fly off immediately if it is expoſed to the Air, and will make its way out of a Bottle through almoſt every thing it is ſtopt with except Glaſs. With all Acids, it cauſes a moſt violent Effervescence, and becomes combined with them into a neutral Salt of a particular kind, according to the nature and origin of the Acid. This Salt, on account of its prodigious fugacity, can ſcarcely be manag'd or reſtrain'd; nor is it eaſy to take it out of the Receiver in a ſolid form. At the bottom of the Retort there will remain a fix'd Salt, which cannot be ſublim'd with the greateſt degree of Fire.

2. Or to 10 ounces of the Flowers, add 3 ounces of Salt of Tartar, and then pouring on 9 ounces of Water, ſhake 'em about, and diſtill immediately through various degrees of Heat, into a Receiver accurately luted on to the Retort. There will preſently then aſcend a fine moiſt Vapour, which will be quickly congealed on the concave ſurface of the Receiver into a ſolid Salt, and will proceed in this manner every moment. When the principal part of the Salt is thus come over, it will then begin to be diſſolved by a Liquor leſs volatile, and more watery than the former Salt. Then remove the Receiver, and applying another, urge the remaining Salt with a ſtronger Fire, till it becomes

comes quite dry. This being done, take the Liquor, and put it into the former Receiver, and ſhake it well about till the Salt is attenuated, and almoſt diſſolv'd, and then put 'em into a clean glaſs Vial, which ſtop very cloſe with a glaſs Stopple. By this means then you will have a Salt at bottom, and a Liquor at top, which is a very ſaturated, true, volatile, alcaline Spirit. But here, if there happens to remain no ſolid alcaline Salt at bottom, it is a ſign that the Spirit is not ſo ſtrong, but is watery, and hence in a great many Experiments it will not anſwer. At the bottom of the Retort there will be left a fix'd Salt, exceeding like the fix'd one in the preceding Proceſs.

USE.

THE *Sal-Ammoniac*, as ſoon as ever it comes in contact with the fixed Alcali in this Operation, is, from the diſpoſition of its own Nature, and the aſſiſtance of the Fire, divided into two parts, which are perfectly diſtinct, though both of 'em ſaline, one of which conſtitutes a very acrid, alcaline, igneous, volatile Salt, which is the pureſt that can be prepar'd by Art, and at the ſame time the moſt ſimple, and hence is ſettled as the ſtandard of volatile Alcali's, to which all that are a-kin may be reduced, whilſt all that differ from it are diſtinguiſh'd by ſome other Title. The true volatile alcaline Spirit of *Sal-Ammoniac* therefore is a Water containing in it as much of the pureſt alcaline Salt as it is capable of diſſolving. To this too, as their Head, may be referr'd all other volatile alcaline Spirits. No other volatile alcaline Salts or Spirits however are ever ſo pure and ſimple as theſe are, being always render'd impure by an Oil, on which account they act in a very different manner. But in this property again, *Sal-Ammoniac* agrees with the Salt of Urine of *Proceſs* 96; for that Salt and Spirit cauſe a ſudden and violent effervescence with all Acids. If a Veſſel, in which there is contained this Salt or Spirit, is left open, and there is another ſet by it full of ſtrong acid Spirit of Nitre, there is preſently excited in the Air a pretty conſiderable effervescence, ariſing from the concurrence of the volatile Alcali, and Acid, as they exhale from the Veſſels. If this Salt is applied to the Skin, and ſo covered with a Pitch-Plaiſter that it can't fly off, as ſoon as ever it comes to be heated, it cauſes an intolerable pain, and produces the higheſt inflammation, with a black Gangrene in the part, ſo that no poiſon acts with more violence. Do thoſe Phyſicians therefore behave altogether prudently, who order this Salt or Spirit to be ſmell'd to very freely, by which means they become applied to the olfactory Nerves, the *Membrana Pituitaria* of the Noſe, and the exceeding tender Veſicles of the Lungs? Certainly a topical inflammation and corroſion ſeem in ſuch caſes much to be feared. Both this Salt, now, and Spirit become ſtill more acrid and fiery, if they are ſublim'd again from a freſh, pure, dry Alcali.

PROCESS CVII.

An Examination of the fix'd Salt that remains in the preceding Proceſs.

APPARATUS.

UPON the Salt, remaining at the bottom of the Retort in the preceding Proceſs, pour as much very clean hot Rain-water as is ſufficient to diſſolve it intirely, and then filter the Liquor till it becomes exceeding limpid. Inſpiſſate this, and reduce it to Cryſtals, till you have almoſt conſum'd the whole in this manner. By this means then you will have a Salt, which, by its Taſte, cubical Cryſtals, and diſſolving Power, almoſt reſembles Sea-Salt. Put this into a Crucible, cover it with a Tile, and let it decrepitate and calcine for ſome time, and then diſſolve and coagulate, and you will have a very pure Salt. This being taken in intermittents to the quantity of a drachm, about 2 hours before the Fit is expected, often prevents the return, if the Body is well warm'd at the ſame time. Hence it has obtained the name of the *Sal Febriſugus Sylvianus*.

USE.

THIS then is the other fix'd ſaline part of the preceding Proceſs, ariſing from the mixture of a fixed Alcali with *Sal-Ammoniac* expoſed to the action of the Fire. This Salt now is neither alcaline nor acid, but a compound neutral one, nor yet is it an ammoniacal, but a fixed one. In order then to account for this, we muſt conſider, that the *Sal-Ammoniac* was produc'd from a volatile Alcali of Urine, a volatile vegetable one of Soot, and an aceſcent, or acid Sea-Salt. The fix'd Alcali, then, which is a moſt powerful attrahent of an Acid, attracts into it the Acid of the Sea-Salt, and ſeparates it from the volatile animal Alcali, or that of the Soot. Hence the Acid of the Sea-Salt being combin'd with the fix'd Alcali, returns again into a fix'd Sea-Salt; and the volatile Alcali of the *Sal-Ammoniac* being freed at the ſame time from its fixing Salt, becomes perfectly volatile, and being collected together, appears in form of a pure Alcali: And this again being ſaturated with an acid Spirit of Sea-Salt, produces a regenerated *Sal-Ammoniac*, as will be demonſtrated *Proceſs* 147.

PROCESS CVIII.

The beſt volatile alcaline Salt, or the pureſt alcaline Spirit, and the beſt Spirit of Vinegar, produce a ſalt Spirit.

APPARATUS.

UPON the pureſt alcaline Salt, or Spirit, put into a clean large glaſs Veſſel, pour a little of the ſtrongeſt pureſt Spirit of Vinegar, ſhake 'em, and mix 'em well together, and proceed in this manner, 'till it will cauſe no farther efferveſcence. Heat the Mixture, and add a little more Salt or Spirit, and if there is then no appearance of an ebullition, it is a ſign that the ſaturation is compleat. By this means, if you proceed in a proper manner, you will have a ſalt Liquor, compounded of a volatile Alcali and Acid, which will not be eaſily reduc'd to a ſolid Salt, and is a moſt penetrating Medicine.

USE.

THIS Liquor is not only the moſt penetrating of any that are uſed in the human Body, but it exerciſes its Office without any corroſion, and by its ſaline, antiſeptic quality, admirably reſiſts the Putrefaction of the Humours. And hence perhaps, as an aperient, attenuant, diaphoretic, diuretic, and ſudorific, it is ſcarcely exceeded by any. Externally applied, by way of Fomentation, it proves an excellent diſcutient and reſolvent. But above all, it is remarkably uſeful in Diſeaſes of the Eyes, when there is any thing opake, either in the *Cornea* or aqueous Humour, if it is properly applied by way of Fomentation. Of all compound neutral Salts, now, perhaps this is the moſt ſubtil, which, without any great impropriety, may be call'd an ammoniacal one.

PROCESS CIX.

The White of a new-laid Egg is neither acid nor alcaline, nor contains any fermented Spirits.

APPARATUS.

SOME Whites of new-laid Eggs, well clear'd from their Shells, Membranes, and Yolks, I have here in theſe clean glaſs Veſſels. Into every one of theſe I pour different Acids, and ſhake and mix them together, and yet there does not in any of them appear the leaſt ſign of an effervescence: Theſe therefore for a while I ſet by. In theſe other two Veſſels I have two portions of the ſame Whites, with one of which I now intimately mix a fix'd Alcali, with the other, a volatile one; and you ſee they continue perfectly at reſt, without diſcovering any ſign of Ebullition. But pleaſe to attend carefully now to the following Experiment, which is pretty ſurprizing. In this tall cylindrical Veſſel there is half an ounce of the Whites, and 2 drachms of Spirit of Nitre; in this other, half an ounce of the Whites likewiſe, and 4 drachms and a half of Oil of Tartar *per Deliquium*; both of them heated to 92 degrees. The Whites now with the Alcali, I throw at once into thoſe with the Acid, and you ſee what a furious Ebullition is excited, and how prodigiouſly they rarefy, ſo as to run out of the Veſſel though it is ten times as big as wou'd contain them, their Colour, in the mean time, being ſcarcely alter'd. But now the Effervescence is over, how ſoon do they contract themſelves again into the ſame ſpace they took up before? But again, if the freſh Whites of Eggs are put into a Cucurbit, and diſtill'd with a heat of 100 degrees, an inſipid Water comes off, which contains nothing at all of Spirits. And laſtly, if theſe Whites are applied to the Eye, or the bare Nerves, they don't excite the leaſt degree of Pain; held to the Noſe, they ſcarcely affect the Smell; applied to the Tongue, they taſte as inſipid, and inert as any thing can do; and to the touch they feel viſcid, and mucous, by no means with any indication of penetrability.

USE.

HENCE therefore it is evident, that in the freſh White of an Egg, there is contained neither an Alcali, nor an acid, nor yet theſe two combin'd together: But it is a thick, viſcid Liquid, quite inert, and perfectly inſipid. It has appear'd however by obſervation, that from this truly animal Liquid, within the ſpace of one and twenty days, and in a heat of 93 degrees, a Chicken has grown under the Hen from a Corpuſcle, ſcarce weighing the hundredth part of a grain, to the perfect Body of an Animal that weigh'd more than an ounce. Here therefore we ſee a Liquid, diſtinct from every other, out of which, by proper cauſes, may be produc'd Fibres, Membranes, Veſſels, *Viſcera*, Muſcles, Bones, Cartilages, all the parts, both tendinous, and ligamentous, the Beak, Claws, and Feathers, and all the Humours too contain'd in all theſe parts. And yet in this Liquid we find a ſoftneſs and inactivity, without the leaſt appearance of any thing acid, alcaline, or ſpirituous, or any diſpoſition to an Effervеſcence. Nay if there ſhou'd happen any Effervеſcence there, the Egg certainly wou'd preſently burſt aſunder. The whole ſubſtance therefore conſiſts of ſuch a Matter as has been deſcrib'd, and demonſtrates to us, from how tenacious and inactive a Maſs may be form'd all the parts of the Chicken, both ſolid and fluid. And yet this very ſubſtance, by a ſomewhat greater degree of heat, is render'd abſolutely unfit for the production of a Chicken, it ſcarcely bearing 100 degrees to any good purpoſe, whilſt at the ſame time a little leſs proves equally prejudicial, fewer than 80 degrees not being ſufficient. By a Heat however, about the middle, betwixt 80 degrees and 100, there is ſuch a wonderful attenuation of this tenacious, viſcid Matter, that the greateſt part of it will exhale through the two Membranes, and the Shell, hardly any thing remaining but the Yolk, Treads, and *Sacculus Colliquamenti*; for the Yolk which is the *Placenta* of the Chicken is not conſum'd in its nouriſhment. In the mean time, however, the ingenious *Malpighi* has demonſtrated, that this White is not a Liquid every were equally fluid, as the *Serum* of the Blood is which circulates through the vital Veſſels, but that this is a compound fabrick, conſiſting of a great many membranous Bags that are diſtinct and fill'd with their proper Liquor, almoſt in the ſame manner as we ſee in the vitreous Humour of the Eye. And hence ſeem to ariſe thoſe Waves, as it were, concentric to the *Sacculus Colliquamenti*, by which the nutritious Juice being gradually attenuated, is at laſt ſtrain'd into the *Amnion* of the Chicken.

PROCESS CX.

The freſh White of an Egg, with the Heat of boiling Water, hardens into a ſolid Maſs.

APPARATUS.

1. IF an Egg is expos'd to a continual Heat of 80 degrees, the White ſoon loſes its tenacity and thickneſs, and becomes ſo ſubtil as to perſpire thro'

the great end, where the Membranes being ſeparated from the Shell, are depreſs'd towards the Yolk from a large cavity. The other part of the White at the ſame time will be diſſolved, grow thin, and ichorous, nor will afterwards harden with the Heat of boiling Water, but becomes fetid, putrid, and very acrid, and deſtroys the vital *Stamina* of the Chicken.

2. The freſh White of an Egg, being thrown into Water 160 degrees hot, loſes its pellucidity, grows white and opake, and becomes concreted into one thick, ſciſſile Maſs. Or if into Water boiling in a glaſs Urinal, you drop a little White, it will be coagulated in a ſurprizing manner, even during the motion of the boiling Fluid, though it is driven about by it on every ſide. Or laſtly, if you put a whole Egg into Water as hot, it will be harden'd in the ſame manner. Hence therefore it appears, that this coagulation does not ariſe from any loſs of the Liquid of the White, diſſipated by this Heat, but from the true action of the Fire applied in ſuch a degree; for it happens in the middle of the Water. Nay if you put the White into a good deal of cold Water, it will harden, and ſeparate itſelf from the Water, when it is towards boiling.

3. If an Egg is boil'd till it is very hard, and you then accurately ſeparate the White from the Membranes, Treads, Yolk, and *Sacculus Colliquamenti*, and lay it in a glaz'd Baſon, it begins gradually to ſweat, as it were, and be reſolv'd into a ſubtil Liquid, which appears of a watery nature, but is a moſt penetrating ſolvent, inſinuating itſelf into the Body of Myrrh and other Subſtances that are diſſolved with difficulty, and effecting a moſt beautiful ſolution.

USE.

BY this Experiment, then we learn how that Matter is diſpos'd with regard to Heat, out of which all the animal parts without exception may be form'd in a ſhort ſpace of time. We ſee here that a certain degree of Heat diſſolves it, that a greater coagulates it, and that a leſs again reſolves it, when it is coagulated. All theſe things therefore are owing to determin'd degrees of Heat, without a proper regard to which nothing can be aſſerted that will always here hold true. Nay and it will appear ſtill farther in *Proceſs* 112, that a Heat exceeding 224 degrees will attenuate and diſſolve the *Coagulum* cauſed by 212. Hence therefore let us be warn'd to pronounce more cautiouſly concerning the diſſolving or coagulating power of Fire with regard to plaſtic, nutritious Humours, or what degrees of Heat will attenuate, putrefy, inſpiſſate, or reſolve them into their parts.

PROCESS CXI.

An Examination of the White of an Egg with Alcohol.

APPARATUS.

IN this clear glaſs Veſſel I have the White of an Egg, upon which I pour ſome of the pureſt Alcohol of Wine in ſuch a manner that it runs very gently down the ſides upon the White; and this I do very carefully for this reaſon, that you may evidently perceive that every part of the ſurface becomes coagulated.

coagulated, as the Alcohol comes at it, whilſt the lower part ſtill continues liquid, and pellucid. As I ſhake them now gently together, the *Coagulum* ſtill ſpreads with the Alcohol, and now I have, by ſhaking them thoroughly, mix'd them well together, the white you obſerve is intirely coagulated. If the Alcohol is heated before you make the Experiment, the coagulation is effected in a greater degree, as it is, too, the ſwifter you endeavour to mix them together; for the Heat and Motion here increaſe the *Coagulum.*

USE.

HENCE again it appears, that the pureſt vegetable Spirits coagulate that plaſtic matter that is the *Baſis* of nutrition; and certainly in that inſtant of time it becomes abſolutely unfit to perform its office. This admixture, however, of Alcohol preſerves the white from Putrefaction. How much then does the plaſtic Matter of Animals tend towards Coagulation? What unexpected Powers does the too great depuration of ſome Bodies produce in 'em? Wine will ſuffer itſelf to be mix'd with this White; the Alcohol produced from it becomes coagulated with the coagulated White; and yet Alcohol diluted with a pretty deal of Water will not coagulate it.

PROCESS CXII.

The freſh Whites of Eggs reſolv'd by Diſtillation.

APPARATUS.

1. I Boil'd ſome new-laid Eggs in clean Water till they were hard, and then nicely ſeparated the Whites, and chopp'd 'em to pieces as clean as poſſible. Theſe then I now throw into a clean glaſs Cucurbit, and fitting on an Alembic apply a Receiver. The whole Cucurbit I place, according to Art, in a Bath of Water, and urge it by ſucceſſive degrees, till the Water in the Bath keeps conſtantly boiling. By this means then there does not appear any Streaks like thoſe of Spirits, but there comes off a ſimple Water, diſcovering itſelf in dewy Drops, and that in ſuch an incredible quantity, as to riſe to $\frac{9}{10}$ths of the whole weight. I patiently continue this Diſtillation with the heat of boiling Water, till not a drop more of this Liquor will riſe. This Water then, upon examination, diſcovers no ſign of any Oil, Salt, or Spirits in it. It is very pellucid, and inſipid, except that towards the latter end it taſtes a little bitteriſh, and is almoſt inodorous, an Oil only at laſt ſmelling a little empyreumatical. Nor does there appear the leaſt ſign you ſee of any Alcali, though I examine it by proper Experiments; nor by any Trial does it diſcover an Acid. I have here ſome pounds of this Water. In the bottom of the Cucurbit, now, pray obſerve what a ſmall matter there is remaining. The pieces you ſee from their former magnitude are contracted into a very ſmall Bulk, and they are of a golden Colour, eſpecially in thoſe parts which were in contact with the Glaſs, but yet they are pellucid, like ſtain'd Glaſs. As I take 'em out of the Glaſs now I find 'em very light, hard, and perfectly brittle ſo that they ſnap, and fly to pieces, having a ſlight empyreumatical Smell, and a bitteriſh Taſte, occaſion'd by the Fire, but

being by no means either alcaline, or acid. This is the firſt *Analyſis* of them.

2. With theſe pieces that are left I fill a glaſs Retort one third full, apply a large Receiver, place the Retort in a Sand Furnace, carefully lute the Joint, and then diſtill with ſucceſſive degrees of Fire to the very greateſt, call'd a ſuppreſſing one. By this means then there riſes a pinguious, oily Spirit, which runs down in Streaks; and at the ſame time a volatile Salt fixes itſelf to the ſides of the Receiver, pretty conſiderable in quantity, with regard to the dried Fragments, but little in compariſon of the whole Whites before the Water was drawn off. Laſt of all, beſides a light, gold-colour'd Oil, mix'd with the former parts, there comes over a black, thick, pitchy one. And when this laſt Oil is forc'd out by the extreme torture of the Fire, then the Earth at the bottom of the Retort, ſtill intimately united with its ultimate, exceeding tenacious Oil, rarefies, puffs up, and riſes to the neck of the Retort, nay, if it happens to be fill'd too full, enters into the Neck, and choaks it up, and hence has ſometimes caus'd the Veſſels to burſt in a very dangerous manner. Continue the operation till nothing more comes off. The firſt oily, pinguious Spirit, then, is ſtrongly alcaline, in every character, as you ſee here, upon being mix'd with an Acid, it cauſes a very violent effervеſcence. By rectification it is reſolved into a volatile alcaline Salt, an Oil, and a pretty inert, fetid Water. The Salt that adheres to the ſides, is perfectly alcaline, very acrid, fiery, oily, and volatile; and the laſt Oil is acrid, cauſtic, and remarkably fetid. The Earth that remains at the bottom of the Retort is exceeding black, ſhining, light, rare, and brittle, and has a fetid Smell from the empyreumatical Oil that is united with it, and a bitter Taſte from the ſame. If this is burnt in an open Fire it produces a little fix'd, white, inſipid, inodorous Earth, from which there can ſcarcely be procured any Salt, it yielding only an exceeding ſubtle Powder.

USE.

HENCE then it appears, that the white of an Egg contains a very great proportion of Water, but that it has nothing at all of an Alcali in it, that will riſe even with 212 degrees of Heat. That matter, therefore, which by a greater degree of Heat is converted into a volatile Alcali, is not by this conſiderable one diſpoſed either to be alcaline or volatile. Hence therefore I infer, that there is no volatile Salt naturally contain'd in it; for in Chemiſtry we call that a volatile Salt that is more ſo than Water, and is carried up with a much leſs degree of Fire. Nor do we diſcover any Spirit here that riſes with this Heat of boiling Water; nor any Oil that ſuffers itſelf to be ſeparated by the ſame; nay, nor is even the *Reſiduum*, after the watery part is drawn off, ſo alter'd by this Action of the Fire as to give any indication of its containing any Salt, and hence, the more liquid part being expell'd, it ſpontaneouſly acquires the appearance of a brittle Glaſs. By this experiment, therefore, we learn, that a volatile Salt may be produced from the White of an Egg, but does not naturally exiſt in it in that form; for after that this Salt is become volatile by its proper degree of Fire, and is ſeparated from the other parts, it will then riſe with 60 degrees of Heat, though it was not to be raiſed before by 300: That volatility therefore is not natural to the Salt of the White, but is communicated to it by the Fire; which is true of its alcaline quality likewiſe. And laſtly, hence too we diſcover, the tenacious adheſion of the Oil to the more fixed parts of the White, whilſt the Water is ſeparated from them very eaſily; and ſee here again, that an animal Coal will never part with all its Oil in a cloſe Veſſel, this adhering ſo obſtinately to the terreſtrial Elements, that no Fire, except in the open Air, can deſtroy the union. Theſe then, Gentlemen, are the notions we ought to form concerning this Matter of the White of an Egg, from which all the parts of the Animal are afterwards produc'd. But how different are theſe from what are generally laid down concerning the chemical Principles extracted from the Matter of Animals! What idea now we ſhou'd form of the ſaline part, that is pre-exiſtent in the White, before the Fire is applied to it, I confeſs I am at a loſs, as it diſcovers itſelf by no mark to any of the Senſes. This indeed we are certain of, that from the exceeding inert and inſipid *Mucus* of the White, may preſently be produc'd, by the ſole action of the Fire, the moſt acrid, igneous, cauſtic Bodies, as well ſaline and alcaline, as oily; but then from compounding theſe together again, you never will make 'em recover their former nature, or ſoftneſs. The natural Heat, therefore, without a progreſſive Putrefaction, does not generate an Alcali in the Body.

PROCESS CXIII.

The freſh white of an Egg will putrify.

APPARATUS.

IF good Eggs, or their Whites, are kept in a Heat of 70 degrees, or more, they begin in a few days to be attenuated, grow fetid, diſſolve, and putrify, and at the ſame time, if the Eggs are whole, they begin to grow empty about the large end, and if they are then boil'd, will not harden, but retain their Liquid form. And this change happens much ſooner in thoſe Eggs that are impregnated, than in thoſe that are not; for in theſe laſt, the greateſt part of the putrid Moiſture exhales, ſo that at laſt the whole Shell almoſt is fill'd only with Wind or Air. If you continue to keep the Eggs or Whites in the ſame degree of Heat, at laſt all the parts grow ſurprizingly putrid, and alcalious, cauſe an effervеſcence with Acids, and in diſtillation, the firſt part that riſes from 'em is an alcaline Spirit, and an alcaline Salt, exactly in the ſame manner as we obſerved in putrified Urine, *Proceſs* 100. If the White is ſuffered to putrify in the open Air, it becomes almoſt totally volatile, exhaling in proportion as the putrefaction advances, and at laſt leaving nothing behind but a few Skins, all the reſt being diſſipated into the Air. In theſe Experiments there is never generated the leaſt Acid.

USE.

IF a little quantity of Egg, putrified to ſuch a degree as to become of an alcaline Nature, is taken into the human Body, it produces very ſurprizing effects there, exciting a *Nauſea*, *Horror*, Vomiting, vaſt Uneaſineſs, a *Diarrhœa*, and Gripings, firing the Bile, and cauſing Heat, Thirſt, and a Fever. Nay, only by its putrid exhalation it brings on a *Horror*, *Nauſea*, and Giddineſs, and wonderfully diſſolves our Humours like a peſtilential Poiſon. This therefore we know to be the nature of that Matter, which is in the next ſtate to being chang'd into all the parts of an animal Body. Only Reſt, now, and ſuch a degree of Heat as has been deſcrib'd produce all theſe qualities in that Matter. Hence therefore we learn its ſpontaneous alteration and corruption. But again, than which nothing is more ſurprizing, if an impregnated Egg is cheriſh'd in a proper Stove, with a Heat of 92 degrees, the parts that are attenuated and alter'd by this Heat, it ſpends for the ſpace of 21 days in nouriſhing, increaſing, and perfecting a Chicken, in which however there does not appear any thing alcalious, fetid, or putrid. Here then the Phyſician may obſerve ſome very wonderful *Phænomena*; for by Reſt, and ſuch a degree of Heat as was firſt mention'd, a thick Matter becomes thin, a tenacious one grows liquid, an inodorous one, fetid, an inſipid one, of a fracid, very acrid, abominable Taſte, an exceeding ſoft one, cauſtic, a non-alcalious one, alcaline, and a very ſweet, latent Oil, vaſtly putrid. Compare theſe Obſervations now with what *Malpighi* has wrote *de ovo incubato*, and you will find ſome things in this Affair that are quite aſtoniſhing. Theſe Experiments now I have made in particular upon the Whites of Eggs, the other parts where it cou'd be done being ſeparated from them, becauſe the white alone is that Matter which ſupplies the embryo with Nouriſhment, all the other parts aſſiſting only to the alteration of the white, that when it is chang'd in a proper manner, it may be applied to the *carina* of the Chicken that is to be brought to perfection by it.

PROCESS CXIV.

The freſh Serum *of human Blood is not acid, nor alcalious.*

APPARATUS.

1. IF the Blood, drawn with a free ſtream from a Perſon in health, and faſting, is ſuffered to ſtand quiet in a clean Veſſel, it ſpontaneouſly, and in a ſhort time ſeparates into two parts, *viz.* a concreted ſolid Cake, and a liquid, yellowiſh, thin *Serum*, which if the Maſs is let alone, is continually increaſed by it. This laſt part I have ſeparated as accurately as poſſible from all the red, and have diſpoſed it into theſe Veſſels before you. Into one portion of it then I pour ſome of the ſtrongeſt Vinegar; into another, Spirit of Salt; into a third, Spirit of Nitre; and into a fourth, Oil of Vitriol; and you obſerve that neither of the Mixtures diſcovers the leaſt ſign of any efferveſcence.

2. In theſe two other Veſſels I have ſome of the ſame *Serum* likewiſe, with one portion of which I mix a fixed, and with the other a volatile Alcali, and you ſee they are perfectly at reſt, without any conflict, or appearance of ebullition.

3. But I now pour ſome of the ſame *Serum* mix'd with a fix'd Salt, upon ſome more mix'd with Spirit of Salt, and what a violent effervescence immediately ariſes? Certainly by the ſwift rarefaction the Bodies take up ten times as much ſpace as they did before, and the ebullition is much ſtronger than ever you obſerve in Milk on the Fire: And this happens even in the cold.

4. This *Serum* has a ſoft, occult, ſaline Taſte: It diffuſes a diſagreeable

Smell, but by no means an acrid or very active one: If a little of it is dropp'd warm into the Eye, it excites no painful ſenſation, but is one of the moſt ſpeedy Demulcents in Ophthalmies, and wounds of that part. And if it is applied to the Nerves laid bare in Ulcers, or Wounds, it is ſcarcely perceived.

USE.

1. I HAVE made frequent Obſervation upon the Blood of healthy Perſons flowing from them upon opening a Vein, upon that ſpringing out of the Arteries when they have been divided by Wounds, or burſt in Hæmorrhages of the Noſe, upon that hauk'd up from an Artery broke in the Lungs, upon that likewiſe diſcharg'd from Dogs, Oxen, Sheep, and other Animals, when they have been opened alive, or had their Throats cut, and laſtly, upon that flying with violence from the Veins of Perſons blooded in the moſt burning Fevers, *Phrenitis*, and Pleuriſy; I ſay I have made a careful Obſervation in all theſe caſes, and yet I cou'd never diſcover in the Blood, the very inſtant it was received into the Baſon from the living Body, the leaſt ſign of any Ebullition, Effervescence, Fermentation, inteſtine Motion, or Rarefaction, tho' it was ſo rapidly agitated in the Veſſels the very minute before. Upon the evidence therefore of theſe Obſervations, I many years ago quitted *Sylvius*'s Opinion, which I was led into purely by the reading of chemical Authors; for I was by this means abſolutely certain, that the Senſes were not able to diſcover any ſuch alcalious and acid Principles in the Blood, as cou'd produce any of the viſible effects that ariſe from the mixture of ſuch Principles, ſuch as Ebullitions, Effervescences, Fermentations, inteſtine Motions, or Rarefactions. I have ventured to aſſert farther therefore, that there really are no ſuch Principles in the Body, for if there were, it wou'd appear at leaſt the very moment the Blood came out of the Veſſels. If a perſon will ſtill inſiſt upon it, that there are ſuch, but that they are ſo quiet, as not to be perceived, I have nothing more to add, only wou'd ask him one Queſtion, and that is, by what Arguments then he will prove that there are? One may doubt, certainly, whether they wou'd be convincing. This however at leaſt is certain, that if there are theſe oppoſite ſaline Principles of the Chemiſts in the Blood, they are ſo weak as to produce no ſenſible effect, and that conſequently it is not ſafe, from a bare ſuppoſition of theſe, to explain any ſenſible Effects by them.

2. The Blood of a healthy Perſon left to itſelf ought rather to be looked upon as a Solid than a Fluid; and yet the Solid that is form'd from it will ſpontaneouſly diſſolve again into a Fluid. Surprizing *Phænomenon*, but certainly true! If it is the Blood of a Perſon faſting, it does not ſeparate like Milk into a Cream, and Whey, but into a ſolid Subſtance, and a fluid one, the liquid part only being yellow, the concreted, of a ſcarlet colour where it is in contact with the Air, but black in thoſe parts where the Air can't come at it. The red part however itſelf loſes its Colour, and that even in the Air, and acquires a yellowiſh one proper to the *Serum*. Nor is there in the *Serum* or any other part, either an Alcali, or an Acid that by being mix'd with its oppoſite will diſcover any ſign of Effervescence, but they are as quiet upon ſuch Mixture, as when Water is poured upon Water.

3. But from this Proceſs we learn particularly, that our Blood is of ſuch a

Nature, that if any acid and alcaline Salts ſhou'd meet together in it, they wou'd burſt in an inſtant into ſuch an expanſion, that the rarefied Matter wou'd take up at leaſt ten times more ſpace than it did before, and as ſoon as ever the *Impetus* of the Effervescence was over, wou'd ſhrink again to its former compaſs: But this is abſolutely repugnant to the Nature, Health, and Life of the Body, and the equable ſtate it is obſerved to exiſt in.

4. This *Serum* contains all that Matter which is propell'd through all the Veſſels of the Body, the red part alone excepted. It has in it therefore every thing that comes afterwards into any of the Veſſels, from the greateſt to the leaſt, and conſequently contains the Matter of Nutrition, from which every thing is prepared that is neceſſary either for growth, or to repair thoſe Particles that are continually wearing away. In it therefore is the Matter of the whole Body, as well the Solids as the Fluids. Hence therefore we infer the excellent uſe of this Experiment throughout the whole Body; and here we ſee the chemical Art ſetting to rights thoſe errors with which it had infected both Philoſophy and Medicine. This plaſtic *Serum* is ſoft and inert, perfectly like the White of an Egg; and as out of that are formed all the parts of a Chicken, ſo this furniſhes all the parts of the human Body.

PROCESS CXV.

Serum *of Blood, being digeſted, grows putrid.*

APPARATUS.

IF *Serum* of Blood is put into a tall open Glaſs, and expoſed to a Heat of 70 degrees, it will grow every hour thinner and thinner, ſo as in the ſpace of three or four days to be quite reſolv'd and ſanious. At the ſame time too, from being almoſt inodorous, it becomes fetid, and exhales a cadaverous Stench; from being inſipid, it acquires a fracid, rancid, acrid, abominable Taſte; and if it is kept in this degree of Heat a few days, it grows alcaline, putrid, and intolerable to our Senſes, evidently diſcovering its alcaline Nature, by cauſing an Effervescence with Acids. If it is committed under theſe circumſtances to Diſtillation, it yields the firſt time a volatile alcaline Salt, exactly as we ſaw in the Whites of Eggs treated in the ſame manner, *Proceſs* 113.

USE.

HENCE then we ſee, that *Serum* when it lies open to the obſervation of the Senſes, by Reſt, and the degree of Heat mentioned, becomes ſpontaneouſly thinner. When it ſtagnates therefore in the obſtructed Veſſels of a ſick Body, by a gentle Heat, and Time, it diſſolves of itſelf, and ſo often opens the Veſſels it had ſtopp'd up. Hence in acute inflammatory Diſorders, when the Body is reduc'd to a moderate Heat, in a certain number of days the obſtructing Matter becomes capable of paſſing on in its Veſſels, as in practice is every day obſerv'd. By the alteration now the *Serum* undergoes in this Experiment it never becomes acid, whatever the greateſt Artiſts write to the contrary, but always grows only putrid. Nor do we ever obſerve here the leaſt ſign of Fermentation, uſe whatever

ever Arts you will to raiſe one, but a determin'd Putrefaction only. It's true indeed, that by thus putrifying it rarifies and produces an elaſtic Air that flies off from it, but not a fermentative ſpirituous one. Nor are there fermented inflammable Spirits generated by this Putrefaction, but other putrid ones, that are volatile likewiſe, and then take Fire: For Excrements having been cloſe ſtopp'd up in a Privy, and compreſs'd together, have conceiv'd a ſtrong inteſtine Motion, and at the ſame time have exhal'd an exceeding fetid Vapour, which upon the application of a Candle, has burſt out into a violent Flame. Hence it has ſometimes happen'd, that a Heat and Rarefaction have been excited in a dead human Body, but only about the *Abdomen*, and then not a very great one. From what has been ſaid then, the Phyſician may learn the ſpontaneous degeneration of the Humours, when they ſtagnate either in their Veſſels, or in the cavities of the Body without 'em. By acid, compound, ſaline, and ſpirituous Bodies, however, the Putrefaction we have deſcribed may be prevented.

PROCESS CXVI.

Serum *of Blood coagulates in boiling Water.*

APPARATUS.

IF into clean Water, boiling on the Fire, you pour *Serum* of Blood, it immediately grows white, and forms a kind of *Coagulum* in the middle of the Water. In this property therefore, again, *Serum* agrees with the White of an Egg, *Proceſs* 116, tho' at the ſame time it muſt be obſerved, that the White forms a more ſolid Maſs than the *Serum*.

USE.

HENCE then we ſee the effect of Heat upon *Serum* of Blood; and how boiling Water acts upon the Humours when it is applied to, and conſequently burns the parts of a living Body. It is plain, that by that means, neither the ſaline parts, nor the Oils of the Blood are rendered volatile.

PROCESS CXVII.

Serum *of Blood hardens with a dry Heat.*

APPARATUS.

TAKE ſome *Serum* of Blood, put it into a clean Veſſel, and gradually bring it to the Fire, and when it begins to ſmoke, that part that is in contact with the Veſſel, will grow opake and white, and coagulate; and thus proceeding ſucceſſively, the whole *Serum* will at laſt be hardened into a white, tenacious, opake, ſciſſile Maſs, lying in Waves, as it were, in the middle of the ſurface, perfectly ſolid, of a ſoft Taſte like that of the White of a boil'd Egg, and having ſcarcely any Smell. If this Maſs is kept in the open Air, it gradually ſweats out a thin watery Liquid, perfectly in the ſame manner, again, as the boil'd White of an Egg does. And here, if the Coagulation is made with a proper degree of Fire, that is to ſay, with ſuch a one as will juſt effect it, and no more, it will then harden without any *Empyreuma*, without expelling any Salt, and without the leaſt appearance of an Alcali. When it is once conſolidated in this manner, there is ſcarcely any thing that will reſolve it.

USE.

HENCE then it appears, that in a certain degree of Heat, and that not much exceeding 100, all our Humours will be together reduc'd into Maſſes, that will not be able to paſs through their Veſſels. A Heat, therefore, of a little above 100 degrees, ariſing either from an internal or external cauſe, cannot be born in the human Body, without the circulation of the Humours being ſtopp'd, and the Perſon being deſtroy'd, the diſorder being firſt viſible in the Head and Lungs, from their proper action's being firſt diſturbed. But here we obſerve particularly, that Heat, by coagulating the Humours, will deſtroy the animal long before it can render the Salts and Oils alcaline, putrid, and volatile. Of what infinite uſe therefore are *Fahrenheit*'s mercurial Thermometers? How certainly do they point out to us the danger that ariſes from the Heat in acute Diſeaſes?

PROCESS CXVIII.

Serum *of Blood coagulates with Alcohol.*

APPARATUS.

INTO ſome *Serum* contained in this clear Glaſs, I now pour ſome very pure cold Alcohol; and immediately in thoſe parts that it comes at, the *Serum* begins to grow turbid, white, and opake. When I ſhake them together, the ſame thing happens throughout, and the whole becomes coagulated, tho' not ſo ſtrongly as the White of an Egg, but in different Portions, cohering leſs firmly together. If I mix the Alcohol with it very hot, the *Coagulum* then becomes a good deal more ſolid. When the *Serum* is coagulated in this manner by Alcohol, it will never grow putrid, but may be kept for years without alteration.

USE.

HERE then we ſee a farther agreement betwixt our *Serum* and the White of an Egg, *viz.* in their Coagulation by Alcohol. That the *Serum* now is not conſolidated by the Alcohol into ſo denſe a Maſs as the White is, ſeems to be owing to the greater ſolidity of the latter: For the White contains the Matter of all the Nouriſhment that is impended upon the Chicken ſo long as it continues incloſed in the Shell, is not very thin, and has nothing putrid in it; whereas the *Serum* of our Blood contains both urinous Particles, and a great deal of Water; but Alcohol, diluted with Water, will not condenſe the *Serum* in ſuch a manner, nor even the White of an Egg. Hence you ſee the efficacy of pure

Alcohol upon our Blood; for it condenſes it like Fire, and preſerves it from a ſpontaneous Corruption, on both which accounts it is the moſt ready ſtyptic we are acquainted with, at the ſame time that it prevents Putrefaction, producing a very thin, indeed, but ſolid Eſchar. For if a Teint dipp'd in the pureſt Alcohol made ſcalding hot, is applied to a bleeding Wound, preſs'd on pretty ſtrongly, cover'd with a piece of Hog's Bladder ſoften'd with Oil, and then ſecured with a proper Bandage, the Hæmorrhage will be immediately ſtopp'd, and the whole dreſſing may be kept on for the ſpace of three days, in which time the Veſſels generally grow together, being wonderfully contracted and conſolidated by the Alcohol. Thus then does Alcohol coagulate all our thicker Fluids, contract the fibrous parts into a hard dry Coalition, and defend both of them from the Putrefaction they are naturally diſpoſed to. A famous inſtance of this we have given us by that excellent Phyſician *Samuel Cabelliau*, in a Leg that was perfectly ſphacelated, which by the help of Spirit of Turpentine, and alcoholiſated Spirits of Juniper, was preſerved from Extirpation for the ſpace of ſix months, without any farther Putrefaction. *Eph. Germ.* Dec. III. An. 5. and 6. p. 495. But thoſe parts of the Body that are made up of exceeding fine Veſſels, ſoon grow hard in Alcohol, together with their contained Humours. No wonder, therefore, that thoſe poor Wretches who uſe this Alcohol, tho' ſomewhat diluted too freely, ſhould be obnoxious to ſuch terrible diſorders of the Nerves, and Polypus's in the Blood.

PROCESS CXIX.

The Analyſis *of Blood by Diſtillation.*

APPARATUS.

1. TAKE the Blood of healthy Perſons drawn from 'em only to prevent a *Plethora*, fill with it a clean glaſs Cucurbit one third full, fix on an Alembic, and ſecuring it with a proper Lute, place the Cucurbit in a Bath of Water, and carefully lute on a Receiver. Then raiſe ſuch a Fire, that the Water in the Bath may have 150 degrees of Heat, and there will riſe a Vapour into the Alembic, appearing, juſt like pure Water, in form of ſcattered dewy drops, without the leaſt indication of any pinguious Spirits. Keep up this degree of Fire as long as any moiſture comes off pretty readily, and then remove the Receiver, and keep this firſt part by itſelf, which is of the ſame weight, colour, and fluidity as Water; has ſcarce any Smell or Taſte; excites no Effervèſcence with any Acid, or Alcali, but mixes as quietly as poſſible with both of them; gives no indication of any thing ſaline, or oily, by any trial whatever; cauſes no painful Senſation if it is dropp'd into the Eye; and if it is thrown upon Flame, extinguiſhes it: It approaches very nearly therefore to elementary Water.

2. This being remov'd, and another Receiver applied, increaſe your Fire 'till the Water in the Bath boils, and you will then have ſuch another volatile, watery Fluid. Proceed to diſtill as before, till nothing more will come away with this degree of Heat, which requires a pretty deal of patience, for at laſt, when the Maſs begins to grow dry, it is ſeparated from it with difficulty. This Liquor then is in every Property perfectly like the former, all that I aſſerted

and demonſtrated to you by Experiments concerning that, holding true of this likewiſe, without any difference at all; which deſerves your particular notice and remembrance. Theſe two watery Liquors now make up almoſt $\frac{7}{8}$ths of the Blood made uſe of in this Operation.

3. The Cucurbit being broke, and the hard Maſs that remains being taken out, it does not by any kind of trial diſcover any thing alcaline, acid, or acrid; but it is inert, having ſomething of an empyreumatical Smell and Taſte. In a dry place too, it may be preſerv'd for a long while in a Box not painted, or it may be reduced to Powder, and kept in that form, as the Apothecaries experience in Goat's Blood.

4. This Maſs, being divided into ſmall pieces, I put into a glaſs Retort, whoſe Neck is cut off ſo low that the Mouth may be very large, and I leave one third part empty. I then gradually urge it in a Sand Furnace, and there comes off a ſubpinguious, oily, bitter, ſub-alcaline Liquor, and then a white, ſolid, volatile Salt, which fixes to the ſides of the Receiver, and the Mouth of the Retort. The Fire being then raiſed by degrees to the greateſt, you will have a golden Oil likewiſe, and a Salt with it to the very end. Theſe being all remov'd, and a freſh Receiver applied, let the remaining Matter be tortur'd with the ſtrongeſt ſuppreſſing Fire, and there will appear ſome white Fumes, which perhaps will never ceaſe, continue your Operation ever ſo long, and together with theſe a thick black Oil; and then the Maſs being melted in the bottom of the Retort, will rarify, puff up, and riſe into the Neck, which if it ſtops quite up, it will in an inſtant burſt the Veſſels to pieces with a prodigious Noiſe and *Impetus*, as I once experienced myſelf, whilſt I was urging it to the Extremity. This however may be prevented by taking a Retort with a large Neck, and cutting it ſo low that the Mouth ſhall be very wide. By this means then, you have an alcaline oily Spirit; a volatile, alcaline, oily Salt; a Salt ſomewhat more fix'd, and more oily; a yellow Oil; and a pitchy black one; in all which there is contained an Alcali, juſt in the ſame manner as we found before in the Diſtillation of the Whites of Eggs, *Proceſs* 112: Nor indeed is there any ſuch conſiderable difference obſerved here, that a Perſon may eaſily take notice of it.

5. The *Reſiduum* in the bottom of the Retort is very black, ſhining, brittle, rare and light, fetid, empyreumatical, and exceeding bitter, but ſcarcely ſalt. This I urg'd in cloſe Veſſels till the Retort was ready to melt, and yet even then it did not leave off fuming, nor did it loſe its black Colour. This therefore is a true Coal of Blood. If this is expoſed to an open Fire, it flames, the blackneſs is conſumed, and there remains a white Earth, in which there could never be diſcovered any acid, or fix'd alcaline Salt. The Sea-Salt, indeed, that we take in with our Food, and which ſuffers no alteration from the vital Powers, is frequently contained in it; and hence if this is afterwards diſtill'd with the Earth, it may yield ſomewhat of an Acid. All theſe *Phænomena* therefore, conſidered together, make it appear, that the White of an Egg, and the *Serum* of Blood, are very nearly of the ſame nature; but the former continues at reſt in the Shell, whilſt the latter is carried ſwiftly through the Veſſels of the animal Body. Thoſe Perſons now, who aſſert that Phoſphorus may be produc'd from this laſt Matter, are perhaps in the right: I am apt to doubt, however, whether ever they have tried it, as there remains ſo little of theſe *Fæces* from the Blood. Reaſoning from Analogy is eaſy; that from Experiments is much more laborious.

USE.

USE.

HENCE therefore it evidently appears, that Water, and a fetidiſh Spirit, are the moſt volatile parts of the vital Humours, and that this Water conſtitutes much the greateſt part of them. But by this Operation we learn likewiſe, that the natural Salt of our Blood can never be rendered volatile in the Body; for we ſee it is not diſpoſed to riſe with a Heat that is 2 $\frac{7}{13}$ths greater than that of a Perſon in health, nay ſcarcely with one that is 3 times greater; but a Heat exceeding the natural one of the Body by $\frac{1}{10}$th only, ſoon proves fatal. But it here appears farther too, that in a degree of Heat 3 times greater than the natural, there does not riſe any thing of a volatile, alcaline Salt, and conſequently that there is none in the Blood. And at the ſame time we ſee likewiſe, that there is here too a pitchy Oil very intimately united with an Earth: That the Blood, when it is depriv'd of its Water, does not diſcover any ſaline Principles: That theſe therefore do not act there at that time as ſuch, nor undergo any alteration, but will lie conceal'd there for years, thus involv'd and unactive, tho' they may be extricated thence by the aſſiſtance of Fire: That Blood will be inſpiſſated by Fire, from 100 degrees to that which is neceſſary to render the Salt of the Blood volatile and alcaline: That when it is inſpiſſated by ſuch a Degree of Heat, the greateſt part of it will again be converted into a volatile Liquid by a greater degree, and then all the parts that are drawn off, except a ſmall quantity of Earth, will continue for the future, volatile, and fluid: That the Blood contains no fermented Spirits: That the Salts of the Blood, which at firſt will not riſe with 276 degrees of Heat, when they are once rendered volatile, can ſcarcely be retain'd from ſpontaneouſly flying off with one of 32: That the animal Salts, by the action of a ſtrong Fire upon them, from not being volatile, are rendered volatile, and from non-alcaline, alcaline, and then continue ſo afterwards: And laſtly, that by mixing together the different parts drawn off from the Blood, the ſame can by no means be produc'd again, but a Compound as different from it as poſſible. Hence therefore we perceive the wonderful difference there is in the effects of Fire upon Blood, according to the different degree in which it is applied. Through all the degrees from 50 to 100, it attenuates it, and renders it putrid; from 100 to 276, it inſpiſſates it; and from this degree again, it attenuates it, and renders many of its parts volatile, acrid, and alcaline. Hence our Aliments, Chyle, Milk, *Serum*, and its productions are underſtood in their original *Species*, and Effects. All theſe things, now, I have found to hold true in the Blood of many Brutes likewiſe.

PROCESS CXX.

The Analyſis *of Horſes Hoofs by Diſtillation.*

APPARATUS.

1. TAKE a ſufficient quantity of the Parings of Horſes Hoofs kept at Graſs, macerate 'em in Water, clean 'em very carefully, and dry 'em again, and then put as much of 'em into a glaſs Retort, as will fill it almoſt to the

lower part of the Neck where it begins to be bent. Place the Retort in a Sand Furnace, lute on a very large Receiver with a Lute made of Linſeed Flower, and diſtill with a gentle Fire at firſt, increaſing it by ſlow degrees. By this means then, there will firſt come off a limpid, watery Liquor, appearing in form of dewy drops. Keep up the ſame degree of Heat as long as this continues to diſtill, and then remove the Receiver, and pour it into a clean Veſſel by itſelf, and apply the Receiver again. Proceed to increaſe your Fire till you perceive white Clouds begin to riſe, and then together with them you will immediately have an oily Spirit, which will run down in oily ſtreaks. Carry on your Diſtillation with the ſame Fire, whilſt any thing will riſe with it, and there will begin here and there to appear ſomewhat of a Salt. Raiſe it ſtill higher, and, with a more pinguious Spirit, there will riſe a volatile, alcaline Salt, that will form itſelf into little Glebules, together with an Oil. This being perſiſted in till ſcarcely any thing more will come over, proceed to urge the *Reſiduum* with the ſtrongeſt ſuppreſſing Fire, and there will ſtill aſcend a volatile Salt, but ſomewhat more fix'd, and with it a very red, thick Oil. At the ſame time too, the *Reſiduum* will melt, run into one Maſs, puff up, and riſe to the Neck of the Retort. Then deſiſt from the Operation, and remove the Receiver before the Retort is grown quite cold, for otherwiſe great part of the volatile Salt will re-aſcend into it. When you have taken out the Bodies in the Receiver, keep 'em in a Veſſel very nicely ſtopp'd, for they are extremely volatile. The *Fæces* that then remain in the Retort, are exceeding acrid, very light, rare, fetid, and bitter, and if they are burnt in an open Fire, they yield a ſmall quantity of a white Earth, that is very inſipid, and conſiderably pure.

2. If you take the oldeſt, drieſt Hartſhorn, break it into pretty large pieces, put it into an iron Pot fitted in a Furnace, and fix on a very large earthen Alembic with two Beaks, and to each of theſe apply a large Receiver; then if you carefully diſtill with ſucceſſive degrees of Fire, there will come off very nearly the ſame principles as in the Diſtillation of theſe Hoofs, *viz.* alcaline, oily, pinguious Spirits; a volatile Salt; a light Oil; a Salt a little more fix'd; and another thick, tenacious, pitchy Oil. But when the Operation is over, there will remain at the bottom a black ſolid Coal, which will not ſo eaſily melt with the Fire, but remains brittle, and being reduc'd to Powder, and given faſting, is an excellent Remedy for the Worms.

3. The freſh Bones of Animals, clean'd as much as poſſible from their Fat, being treated in the ſame manner, produce the ſame parts, ſetting aſide that from the great abundance of a very fetid, putrid Oil, the whole is rendered exceeding impure. The ſame may be drawn too from Horns, Claws, Hair, and Silk.

USE.

AS there is a greater or leſs quantity of Water, therefore, drawn from all theſe Bodies, let 'em be ever ſo dry, hence it appears how intimately this adheres to the other Elements of Animals, and is conſolidated with them into an exceeding hard, dry form, which remains fix'd and durable for a great number of years, till it is at length reſolved by Fire. This now appears particularly, when you free the liquid Spirit from its volatile Salt and Oil, for then you have a fetid Water in conſiderable quantity. But hence we learn farther, that Bodies that are perfectly inodorous, by the ſole action of the Fire, acquire a manifold and very various fetid Smell; for every one of theſe different parts has a particular kind of fetidneſs, which it is ſcarcely credible, how long they will retain. From the moſt inſipid Body, likewiſe, we here ſee a Production of various Taſtes, for neither the Water, Spirits, Salts, or Oils, have the ſame. But from a ſolid Body, how many Fluids have we here too, that will not, without vaſt difficulty, become concreted again? And from a fix'd Body, how many volatile ones? Certainly of the whole large Maſs there is but a ſmall quantity of Earth that remains fix'd. And as the very ſame Principles are drawn both from the fluid and ſolid parts of the Body, with this difference only, that after the Diſtillation of the firmer parts, there remains more Earth, hence we eaſily ſee, that they have one common Nature, and that the Solids are made up of the Fluids. If the larger Bones, however, are calcined with a very pure and intenſe Fire to a perfect whiteneſs, not only on their ſurface, but to the very inmoſt part of their ſubſtance, tho' they will retain their proper form and ſize, yet upon being expoſed to the action of the Fire in a cloſe Veſſel, they will not yield any Water, Salt, Spirit, or Oil, but they are eaſily reduced to Powder; tho' even then, if they are immerſed in Water or Oil, they will acquire a conſiderable degree of coheſion. And again, if Horns, Bones, or the like parts are boil'd ſtrongly, and for a long while in Water, often ſhifting the Decoction, and putting on freſh, and this is continued till the laſt Water, after boiling ſome time, is as pure as when it was put on, then all theſe Decoctions being mixed together, and inſpiſſated, will form a thick Jelly, which when it is cold, acquires ſuch a conſiſtence, as to ſtand againſt the Knife. And if you then take ſuch a Maſs prepared from Hartſhorn, Ivory, Bones, or Fleſh, and diſtill it in the manner diſcrib'd, it will yield the very ſame parts as before; and the horny or bony Subſtance that remains after ſuch a thorough Decoction, will give out in Diſtillation ſo much leſs Salt, Oil, and Spirit, as there was Jelly boil'd from it. Hence therefore it appears, that all that ſaline, ſpirituous, and oily Matter, proceeds only from the Fluids, and that the ultimate ſolid parts are mere ſimple Earth, cohering but ſlightly together, in which, after it has ſuffered the utmoſt torture of the Fire, there is not diſcovered the leaſt ſign of a fix'd Salt, nothing then remaining but white Aſhes, which are exceeding fit for making the aſſaying Teſts with. And if you boil Bones in this manner in *Papin*'s Digeſter, as I have formerly frequently done, when the Decoction has been repeated ſufficiently, they will be found almoſt purely earthy. Theſe things therefore being all laid together, have inform'd me, that there is ſcarce any deſcernible difference in the principles produced by Diſtillation from any animal Subſtance, except only with regard to the Oil, which is in greater plenty in ſome parts than others. But the Oil in Diſtillation becomes intolerably empyreumatical, and infects all the other parts with a moſt abominable and indelible Smell and Taſte. Hence it comes to paſs, that a ſolid part, when it is diſtilled, becomes proportionably more offenſive, as it contains more Oil, for which reaſon, the Bodies which lean Hartſhorn yields in Diſtillation, are in this reſpect different from what you procure from an Ox's Bone that is full of Marrow. But ſetting aſide this one conſideration, in other reſpects there is hardly any difference; for the Spirits and Salts being freed from their Oil, become very nearly the ſame.

Nor could I ever diſcover any conſiderable variety in the Chemical Productions from different Animals; for Horſes Hoofs, Bullocks and Harts Horns, Ivory, Tortoiſe-ſhell, Hair, and Silk, yield the ſame Principles. And hence again it ſignifies little from which they are procured, ſetting aſide the regard to the Oil already explained. Thus in the Spirit of human Blood, Hartſhorn, Horſes Hoofs, and raw Silk, I never could find any diſagreement, but in their Oil. I know indeed, that *Van Helmont* extolls the ſaline Spirit of human Blood above all others, on account of its curing the Epilepſy; and that the *Engliſh* prefer *Goddart*'s drops made from Silk, to any of the like kind; but I have been long ſatisfied, that ſuch a difference in their effects is ſeldom obſerved in Practice with ſufficient certainty. This however, in the mean time, we are ſure of, that by boiling the Solids of Animals with Water, all that Matter may be nearly extracted, which in Diſtillation yields thoſe parts we have been deſcribing, the Body that remains after the Decoction yielding very little: That hence in theſe inſipidiſh, and ſcarcely odorous Decoctions, all that Matter lies concealed, which in Diſtillation gives out the Salts, Spirits, and Oils: And that the animal Salts, therefore, by ſuch long and repeated boiling, cannot be rendered alcaline and volatile. But it is farther certain too, that Air, Water, and Salt, will in time abſolutely deprive Bones of all that animal Matter, which in Diſtillation would yield Water, Spirits, Salts, and Oils; and that old Bones by this means rendered perfectly white, upon being committed to Diſtillation, afford nothing of this, but exhibit only a very ſimple Earth, all the other parts being carried off by the previous Putrefaction. And laſtly, which is a pretty Experiment, if you take the Muſcle of an Animal, a Bullock's Heart for inſtance, and boil it in freſh Waters till you can boil nothing more out of it, and then take it, and ſoftly preſs out the Water, and ſqueeze it gently betwixt your Hands, and then boil it again in more Water, and ſo proceed, taking off the external fine Membrane, that the melted Fat may eaſily diſcharge itſelf; I ſay, if you treat it carefully in this manner, you will at laſt have a dry ſolid Muſcle, which will not corrupt, and is exceeding fit for the examination of its Fibres, eſpecially if you firſt inject warm Water into the coronary Veſſels till you have thoroughly waſhed both the Arteries and Veins from their Blood, for by this means you will obtain a Skeleton of the Muſcles.

PROCESS CXXI.

The Depuration, and Separation of the Bodies produced by Diſtillation, from alcaleſcent Vegetables (Proceſs 33.) or from vegetable Soot (86) or putrefied Vegetables (88), or Animals (95, 101, 112, 119, 120); *with their Vertues when thus purified.*

APPARATUS.

1. I Here, as you ſee, take all the Bodies procured by Diſtillation in the *Proceſſes* cited, and mixing them together, put them into a pretty large glaſs Cucurbit, which I then ſet apart for this Work. To this I apply a large Head, whoſe Beak I cut off in ſuch a manner as to have the Mouth pretty wide, that the Salt may readily paſs into the Receiver, which would otherwiſe be eaſily ſtop-

ed there, and cloſing up the Orifice, might cauſe the Head to fly off with a great deal of violence. This being done, I place the *Apparatus in Balneo Mariæ*, and with a Heat of 150 degrees, kept up juſt to the ſame height, I draw off whatever will riſe with that degree. By this means then I have a pinguious alcaline Spirit, that is perfectly volatile, and with it a white, ſolid, volatile Salt. When nothing more comes off with this Fire, the Receiver muſt be removed, and this Spirit muſt be kept by itſelf, together with this volatile Salt. And if then, upon ſhaking 'em together, the Salt will be no farther diſſolv'd by its Spirit, it is a ſign that the Spirit is as generous and ſtrong as it can be prepared by any Art. Let this therefore be poured off, and be kept ſtopt as cloſe as poſſible for its proper uſes, under the Title of true Spirit of Hartſhorn, Human Blood, *&c.* The Salt likewiſe, which would not be diſſolved in this Spirit, may be kept in another Veſſel, under the Title of a volatile, oily Salt of Hartſhorn, *&c.*

2. Let the *Reſiduum* be then urg'd with the heat of boiling Water, and you will have another Spirit that will riſe ſlower than the former, together with a light Oil ſwimming upon it, and a ſmall quantity of a volatile Salt. Proceed to diſtill with this degree of Heat as long as any thing comes off, and keep this aqueous, oily, and ſaline Liquor by itſelf. This being done, at the bottom of the Cucurbit there will remain a thick fetid Oil.

3. Hence then you have from theſe Bodies, firſt, a Water that is neither oily nor ſaline; then an alcaline oily Spirit; next a volatile oily Salt; fourthly, a volatile Oil, with an oily Alcali, a little leſs volatile, together with a fetid Water; and laſtly, an Oil ſo fix'd, that it won't riſe with 213 degrees of Heat.

4. If the firſt Spirit is ſublim'd in a freſh Veſſel with a Heat of only 100 degrees, you will then have a purer Salt almoſt in a ſolid form; and if you proceed ſo long till the ſublim'd Salt begins to be diſſolv'd by the following Liquor, then at the bottom there will be left a watery Liquid, together with an Oil ſwimming at top. Hence, therefore, theſe Spirits conſiſt of a very light Water, Oil, and Salt, combin'd together, and hence they are capable of being reſolved into theſe three again. Theſe Spirits therefore are a volatile, ſaponacious *Lixivium.* And the reſiduary Water and Oil may, by a new Diſtillation, be ſo ſeparated, that an inſipid, but fetid Water, and an Oil, may be obtained diſtinct, all the Salt being carried off by the moſt volatile Oil. Hence then we underſtand the nature of theſe Spirits. This Salt, however, thus produc'd by Sublimation from its Spirit, is always oily, tho' leſs ſo indeed than it was before, and hence it is whiter; for in every repetition it leaves a yellow, and ſometimes a red Oil behind it, from which it had its Colour. But when the Spirits of *Proceſs* 106, that are not oily, but merely aqueous and alcaline, are treated in this manner, then a volatile alcaline Salt riſes alone in a dry form, and there remains a proportionably leſs ſaturated alcaline Water at the bottom. Hence, therefore, we learn, that when by Putrefaction the admixture of a fix'd Alcali, or the action of the Fire, the Salt of Animals is once render'd alcaline and volatile, by this very means it becomes and continues more volatile than pure Water, and the moſt volatile Oil; and hence the Water that is left behind, diſcovers the Oil that lay concealed before; for whilſt this was united with its Alcali, it was of a ſaponacious nature, and ſo wou'd diſſolve in the Water, but its Alcali being now ſeparated from it, it no longer retains this

ſoapy quality, but like true Oil diſengages itſelf from the Water, and appears in a diſtinct Body.

5. Let the Oil that is ſeparated from the other parts, in the rectification of the Spirits, be mix'd with that which remain'd at the bottom of the Cucurbit No. 2. Upon theſe pour ſome clean warm Water, and ſhake 'em together, in order to diſſolve any Salt that may adhere to the Oil, by which means the cauſtic acrimony of the Oil will be in a great meaſure deſtroy'd, and it will become milder. Decant this ſaline Water, and ſet it by, that the Salt may by ſublimation be ſeparated from it. Put the Oils into a Cucurbit, and with 213 degrees of Heat free 'em from their Water, keeping up this Heat till nothing more can be drawn off, and then diſtill them with a clean Retort into a pretty large Receiver, beginning with a moderate degree of Fire, and gradually increaſing it, till you can't force out any thing farther with the ſtrongeſt Sand Heat. By this means then the Oil will become thinner, more limpid, and leſs fetid, and there will be a black Earth left in the Retort. And if you repeat the diſtillation a ſecond time upon theſe black *Fæces*, the Oil will become ſtill more limpid, purer, thinner, and leſs fetid, and you will again have more Earth left behind, ſo that every time the quantity of Earth will be increas'd, whilſt that of the Oil is diminiſh'd, which continually advances in limpidity, purity, and ſubtlety. And indeed of this there is ſcarce any end, as I once had an opportunity of obſerving, whilſt, according to *Van Helmont*'s direction, I attempted, with the utmoſt Patience, to prepare the oily diaphoretic which he mentions in his *Aurora Medicinæ*; for he there orders the Oils to be diſtill'd till they will no longer leave behind 'em any earthy *Fæces*. I took therefore ſome pounds of Oil of Hartſhorn, diſtill'd it in the manner deſcrib'd, and cohobated it a great number of times, but there was always ſome feculent Matter left behind, ſo that at laſt I had loſt the greateſt part of my Oil, obtaining only in the room of it a good deal of uſeleſs Earth, of which I found there was ſome left at the bottom of the Retort the very laſt Diſtillation. By this means, however, I procur'd a very penetrating Oil, that was not unpleaſant. Hence therefore I was ready to believe that *Van Helmont* had never brought this Experiment to a concluſion himſelf, which he recommends to others; and was ſatisfied that the Great *Boyle* tells us upon better authority in his Treatiſe *Of the Mutability of Principles*, that by an obſtinate cohobation almoſt all theſe Oils are converted into Earth, and that then the Acrimony is taken away that remain'd in the Oils after the Salt was waſh'd out of them. Any Perſon however will find it worth his while to cohobate theſe Oils fifteen times, for by this means he will obtain an Oil that is almoſt as thin as a Spirit, is pellucid, exceeding penetrating, volatile, of a grateful Smell and Taſte, that penetrates wonderfully through all the paſſages of the Body, is an anodyne, paregoric, reſolvent, and febrifuge, is greatly beneficial to the Nerves, and being rubb'd upon the Spine of the Back before the Fit, proves ſerviceable in Intermittents: The Doſe from 20 drops to 30. See *Dippelius de Morb. H.* and the famous *Hoffman Ob. Ch. Phyſ.* C. I. Hence therefore we ſee, that theſe Oils are convertible into a very large proportion of Earth, and a very ſmall one of true Oil. But when they have undergone ſuch a management, then they all become of the ſame Nature, and ſcarcely to be diſtinguiſh'd from one another, ſo that diſtill'd animal Oil, when it is perfectly freed from every thing elſe, ſeems from all Animals to be intirely the ſame.

6. Laſtly, the volatile Salts of Animals are depurated after various methods in order to procure them ſimple, and free from the admixture of any other Body; and theſe are as follow.

1. I take this large Bolthead that has a very long large Neck, which I cut off in that part where it is wideſt. Into this I put ſome volatile Salts that are not very pure, and fitting on a Head that has a large Beak, and applying a Receiver, I gently urge them with a ſoft Sand Heat: By this means the Salt aſcends to the top of the Alembic, and the Neck of the Bolthead. I continue this Operation till nothing more riſes, and then take out the pure Salt, and keep it in a cloſe Veſſel, there remaining at the bottom of the Bolthead an Oil and fetid Water. In this method however there is always ſome Oil aſcends with the Salt, though by a ſecond ſublimation, great part of this will be again left behind, and the Salt will riſe more pure. And here the Salt procur'd from Urine, Whites of Eggs, Blood, Horns, and Bones, when it is rectified in this manner, becomes at laſt perfectly the ſame; for by a repetition of this Operation I have at length brought them to ſuch a likeneſs that I cou'd not diſtinguiſh them from one another, and always the leſs, the oftner the ſublimation had been repeated. Hence then it appears, that all the difference obſerved betwixt volatile alcaline Salts is owing only to the empyreumatical Oil that adheres to 'em, which being carefully and intirely remov'd, the remaining depurated Salts become perfectly alike: Though it is very white however juſt after the Operation, yet in time it grows yellowiſh, a latent Oil diſcovering itſelf a-new. This thoſe Chemiſts find greatly inconvenient who prepare Salt of Hartſhorn for ſale, and therefore want to give it an agreeable whiteneſs that will laſt a good while.
2. This ſecond method therefore I have found to ſucceed very well. Take the Salt once purified by ſublimation in the manner deſcrib'd, put it into a tall glaſs Cucurbit, and immediately throw upon it 4 times as much of the pureſt, drieſt, hot Chalk, reduced to a very fine Powder, which muſt be done in ſuch a manner that the Salt may be well cover'd with it. Fit on, as ſoon and as cloſe as you can, a clean, dry Alembic, which will be ſo much the properer for this Operation, as it is bigger and has a Beak with a wider Mouth. Then lute on a Receiver, and diſtill with only a gentle Warmth, which will be beſt directed by the warm Bath. By this means then all the Salt will be ſublim'd white, pure, alcaline, and volatile, whilſt almoſt all the Oil will be retain'd in the dry bibulous Chalk. At the ſame time too the Chalk, by its admixture, will make no alteration at all in the nature of the Salt, inviſcating only the Oil, and by this means rendering the Salt more ſimple and pure. And indeed the Salts prepar'd in this manner will continue for a great length of time without any alteration, eſpecially if they are accurately rubb'd with the Chalk before they are ſublim'd: But then it's true a good deal of the volatile part exhales during the rubbing, and the Salt grows very ſoon moiſt with the Air, and diſſolves.
3. Laſtly therefore, if upon the Salt thus depurated by Chalk you pour as much pure Spirit of Sea-Salt as is neceſſary to a perfect ſaturation, then diſſolve the *Sal-Ammoniac* thus produced in Water, filter the Liquor till you have reduc'd it to the greateſt purity, inſpiſſate it to a Salt, and then diſtill

this Salt with a fix'd Alcali, according to *Proceſs* 106, you will by this means have a very white, pure alcaline Salt, perfectly ſimple, and intirely freed from all its Oil. See the *Phil. Tranſ. abr.* Vol. III. p. 335, where you have this elegant Invention very well deſcrib'd. After the volatile, alcaline, oily Salts now, mentioned in the title of this Proceſs, are by theſe three methods brought to their greateſt ſimplicity, there is then no ſenſible difference to be obſerved in them, and that whether they naturally reſide in the Bodies, or are produced by Putrefaction, or Fire. And, exactly in the ſame manner, may the ſame be procured from Birds, terreſtrial, and amphibious Animals, Fiſh, Reptiles, and thoſe Creatures that live in the Earth, as likewiſe from alcaleſcent Vegetables, Soot, &c. So that all theſe, when they are freed from their Spirit and Oil with Spirit of Sea-Salt, produce the very ſame kind of *Sal-Ammoniac*, which being again reſolv'd by fix'd Alcali's yields the alcaline Salt and Spirit of *Proceſs* 106. Hence therefore, in the whole compaſs of Nature, there is but one volatile Alcali that we are at preſent acquainted with, that is to ſay, when it is perfectly freed from every thing elſe. The difference therefore that is obſerv'd in it, when it is not ſo pure, depends always upon the admixture of ſome other Principle, particularly upon an Oil that adheres to it, which in various Bodies is more different in its Nature; though even this Difference that appears in the Oils is principally owing to a ſmall quantity of Spirit, and ſo ultimately this diverſity in the Salts will ariſe chiefly from the Spirit that reſides in the Oil. Hence therefore we ſee that the Water, Earth, and Salt of Animals, when, by the methods laid down, they are reduc'd to their ultimate ſimplicity, are perfectly the ſame without any difference at all. The diſtinguiſhing quality therefore of every one of them reſides chiefly in the Oil alone, which itſelf too, is diſtinguſhed by its Spirit, ſo that this being intirely remov'd, even the Oils themſelves become wonderfully like one another: In Animals therefore the *Spiritus Rector* again cauſes the principal difference, as we have already made appear it does in Vegetables. Theſe then are the ultimate and very ſimple effects of this chemical *Analyſis:* If the Artiſt endeavours to proſecute his labours any farther, he almoſt loſes the fugitive corpuſcles, which when they are alone don't conſiderably cohere together, but being properly united with one another, form infinite numbers of compound Bodies. It's likely now, you may deſire that I ſhou'd chemically explain to you the properties of this pure, volatile, alcaline Salt, and therefore I'll give you the chief of them, which are as follow.

1. It cauſes, in the ſame manner that a fix'd Alcali does, a pretty ſtrong Efferveſcence with every known Acid, which continues too a conſiderable while. At the ſame time too it unites itſelf ſtrongly with the Acid, retains it powerfully, and with it conſtitutes a compound Salt, the kind of which is determined by the attracted Acid: And by this means, in a perfect ſaturation, it is increaſed $\frac{37}{98}$ths of its weight. Hence then we learn the proportion betwixt the Alcali and Acid that is neceſſary to bring them to an *Equilibrium*, and how much of each of them may be expected again in the reſolution of theſe compound Salts. As ſoon as ever now this point of Saturation is obtain'd, the action of the Salt thus produced muſt not

be judg'd of from the Acid or Alcali that enter into the compoſition, but from the particular nature of this new Salt. Hence therefore the error many Perſons have fallen into is eaſily refuted, who imagine compound Salts have the ſame Vertues, which they obſerve in the ſimple Salts into which they may be reſolved.

2. This Salt, being put into action by the Heat of a healthy Body, very ſoon inflames, burns, converts into a gangrenous Eſchar, and hence perfectly deſtroys every part to which it is applied in ſuch a manner that the Motion excited by this Heat ſhall be kept determin'd upon it: For if a ſcruple of pure volatile Salt of Hartſhorn is laid upon the Skin, and preſently ſecur'd with a Pitch Plaiſter, within half a quarter of an hour there will be raiſed a ſurprizing black Carbuncle, in the ſame manner as if it had been burnt with a red-hot Iron. The Colour, Pain, Heat, and ſhrivelling up the Skin too, is always exactly the ſame. And as for the Humours it reſolves them, and renders them thin, and ſanious.

3. It is wonderfully mobile, and volatile, in this particular, even exceeding all the Bodies we are acquainted with; for in mobility it goes beyond Alcohol and every thing elſe. If Water, Alcohol, and this Salt are mix'd together in a tall Bolthead, and you fix on an Alembic and apply the leaſt degree of Fire, the Salt will riſe alone into the Alembic long before the Alcohol, which will aſcend next, the Water riſing laſt of all, and that not without difficulty. And in the ſame manner this Salt flies off from every heating point. Thus if you lay it open upon your hot Hand, it preſently flies off without giving it any pain, for it does not react a great deal upon the heating Body, but quitting it immediately leaves it unaffected; in which particular it differs greatly from a fix'd alcaline Salt, which by its weight remains unmov'd. In the mean time however, when theſe volatile Alcali's have enter'd into our Veſſels, and are there agitated by the vital Heat, and the *Impetus* of the circulating Fluids, they then, by their acrid, corroſive, ſtimulating quality act very powerfully upon the ſenſible *Fibrillæ* in particular of the nervous Syſtem, which they excite into a greater degree of motion, and at the ſame time diſſolve the Humours, and thus promote Perſpiration, Sweat, Urine, and a diſcharge by the ſalival Glands. If its volatile Fume too mix'd with the Air, is drawn in, and applied to the *Membrana Pituitaria* of the Noſe, Mouth, *Fauces*, and Lungs, by the irritation it cauſes, it reſolves the *Pituita* when it begins to grow viſcid there, and thus has often beautiful effects, when it is made uſe of with Judgment.

4. In watery, acid, auſtere Diſorders, therefore, of the Humours, in a *Languor* of the nervous Syſtem, and in thoſe caſes, where from a too eaſy mobility of the *Senſorium Commune*, the *Impetus* of the animal Spirits is irregular, and they ruſh into particular Muſcles without the direction of the Will, this Salt is greatly ſuitable, and is of excellent ſervice. And hence in hypochondriacal and hyſterical Affections, Epilepſies, and Convulſions, it proves a ſucceſsful Remedy. If it is diluted with Water, and received into the *Vagina* in form of Vapour, it is look'd upon as one of the moſt expeditious Emmenagogues, when it is prudently adminiſtred, and the conſtitution of the Body requires ſuch an Evacuation. In an alcalious, putrid,

and broken ſtate of the Humours, and in thoſe Bodies which are too much in motion already, it proves a deſperate Poiſon. It may be applied outwardly too as a Cauſtic for burning ſmall Iſſues, and extirpating Warts, and the grandinous Tubercles of the Eye-lids. In theſe caſes you take a little Pellet of Lint, and wetting it with a ſolution of this Salt, apply it to the place to be corroded, covering it with a little Plaiſter of *Diachylon cum gummi*, and then leaving it till you think it has perform'd its Office.

PROCESS CXXII.

A Soap made with a pure volatile alcaline Salt, and Alcohol.

APPARATUS.

I TAKE an alcaline Spirit of *Sal-Ammoniac*, ſo ſtrong that a good deal of its Salt remains undiſſolv'd at the bottom, and put ſuch a quantity of it into a very clear, clean, dry, cold, cylindrical Glaſs with a narrow Mouth, as will fill it near half full. Upon this I then very gently pour as much choice cold Alcohol as will fill the Veſſel, taking care that it don't directly fall upon the Spirit, but run ſoftly down the ſides. This then being done, you ſee there is a white *Coagulum* form'd on the ſurface of the alcaline Spirit, upon which the Alcohol, which is lighter, diſpoſes itſelf. I now therefore turn up the Veſſel, and you ſee wherever the Alcohol and alcaline Spirit come into contact there immediately appears a white opake *Coagulum*; and when by ſhaking 'em, as I do at preſent, they are thoroughly mix'd together, the whole Compound becomes white, opake, and of a ſolid conſiſtence, and that to ſuch a degree, that upon turning the Veſſel upſide down there does not one drop run out. If you ſtop the Veſſel nicely, however, and ſet it by, you will in a ſhort time find it diſſolve again into a Liquid ſwimming at top, and a denſer, ſaline Subſtance collected at bottom, ſo that in a year's time there will be an almoſt ſolid Salt at the bottom with a Liquor above it. If the whole Maſs produced in this manner is committed to diſtillation with a gentle Fire, from the Alcohol, and dry Salt, there will be ſublim'd a ſolid alcaline Salt that is balſamic, and oily. The colder now the Weather and Place is, in which this Experiment is made, the more ſucceſsful will be the event.

USE.

THIS is one of the moſt difficult amongſt the chemical Experiments, as both theſe Liquors are required ſo perfect, and ſo many circumſtances muſt be obſerv'd, one of which being neglected, it will never ſucceed, though it conſtantly will if they are all rightly attended to. Here then you learn, that a pure volatile alcaline Salt attracts into it the moſt ſubtil Oil we are acquainted with, *viz.* Alcohol. And hence it comes to paſs, that the Soap thus produc'd is the moſt ſubtil and penetrating of all, as it conſiſts of the moſt ſubtil and volatile Alcali and Oil, ſurprizingly combin'd together in an inſtant. Hence this Medicine being diluted with Honey and Water, and taken faſting, makes its way into almoſt all the Veſſels of the Body, reſolves Obſtructions, frees the Veſſels, and at the ſame time incites the vital Powers, by which means, when the Diſorder ariſes from ſuch a Matter as is diſpoſed to ſubmit to theſe kind of helps, it very happily cures many Diſeaſes, and thoſe bad ones too. As it is of an exceeding volatile nature however, and its vertue ſoon goes off, it is not capable of ſubduing the more ſtubborn. In the Jaundice it is greatly extoll'd, where there is no conſiderable inflammation. It will not diſſolve the human *Calculus*, nor prevent its concretion and increaſe. It ſeems to be of the ſame nature with Salt of Tartar render'd volatile. In a gentle Heat it becomes fluid; in the Cold it comes nearer to the form of a Solid. If the pureſt Alcohol is mix'd in the ſame manner, in a glaſs Veſſel, with one third as much of a very dry volatile Alcali, you have a Soap that is a good deal ſolider, for then there is no Water in it, whereas in the ſtrongeſt alcaline Spirit, there is always twice as much Water as Salt. *Van Helmont* was afraid that this wou'd quickly generate a *Calculus*; but certainly without reaſon; for this Soap, quite different from a human *Calculus*, diſſolves with Heat, may be diluted with Water, and being ſpontaneouſly volatile, all flies off: They have nothing therefore common to them both, nor is there any reſemblance between them. *Van Helmont* was not the Author of this Experiment, but *Raymond Lully*, a long time before him: This Compound however is call'd the *Offa Helmontiana*. Nor did the Author of that *Engliſh* Treatiſe *Of the Liquor Alcaheſt*, ſuppoſed to be Dr. *George Starkey*, ſufficiently conſider the matter, when he ſuppoſed this Soap, reduced to a Liquor by repeated diſtillation, to be the *Alcaheſt* of *Helmont*.

PROCESS CXXIII.

A ſimple aromatic volatile Salt of Angelica.

APPARATUS.

1. TAKE of the freſh ſmall Roots of Angelica, dug up in February, 2 ounces, cut 'em to pieces, put 'em into a Retort, pour upon 'em 12 times as much Spirit of Wine once rectified, and then add 1 ounce of pounded *Sal-Ammoniac*, and 3 drachms of Salt of Tartar. This being done, immediately lute on a Receiver, and diſtill with a gentle Heat, not exceeding 150 degrees. By this means, then, there will come over into the Receiver a white, alcaline, alcoholiſated Salt. When this ceaſes to riſe, increaſe your Fire a little, and the Spirit of Wine will come off, and appear in very oily ſtreaks. Proceed as long as you have any of theſe Spirits, and when the Salt begins to be diſſolv'd by the watery part that aſcends laſt, deſiſt from the Operation, and put the Liquor thus prepared into a Veſſel, which muſt be ſtopp'd very cloſe. What remains after the Diſtillation throw away.

2. Take an ounce more of the ſame Roots, cut very ſmall, put 'em into a Retort, pour upon 'em the Liquor drawn off before, and diſtill till the Salt, which will come off firſt, begins to be diſſolv'd. Shake the Salt and Spirit, till they are thoroughly mix'd together, and ſtop 'em in a Veſſel as cloſe as poſſible, under the Title mention'd.

USE.

THE Alcali of the Tartar, abſorbing the Acid of the *Sal-Ammoniac* (*Proceſs* 106.) ſets its pure Alcali free, and ſo renders it volatile, which being united with the pure diſtill'd Spirits of Wine, makes with theſe the volatile Salt of the preceding Proceſs; and with this again, from the natural diſpoſition of the Alcohol, the *Spiritus Rector* of the Angelica unites itſelf, which reſides in its balſamic oily part, and is very volatile. Hence the nature of the Alcohol, which equally unites with all theſe kinds of Spirits, is here determin'd by the particular Spirit of Angelica, ſo that now we have a Spirit of Angelica according to *Proceſs* 69. In the mean time too, the volatile and fix'd alcaline Salts, and the acid Spirit of the Sea-Salt, help to open the Body of the Angelica during the Diſtillation, and thus cauſe it to give out its Oils and Spirits more ſucceſsfully. The Liquor thus produc'd, on account of its fragrance, grateful taſte, penetrability, mobility, and ſaponacious, anti-acid, and anti-auſtere vertue, furniſhes us with a Medicine, which, in the Hand of a ſkilful Phyſician, may be uſed with great ſucceſs: For it is of ſervice in all watery, pituitous, cold, acid, and auſtere Diſeaſes, in caſes where the Bile don't perform its office, and in almoſt every Diſorder, where there is a *Languor* without any Inflammation and Putrefaction, particularly, when at the ſame time, an irregular mobility of the Nerves and Spirits, cauſes ſuch troubleſome hypochondriacal and hyſterical Paroxyſms; and in *Flatus's* that ariſe hence, it proves an excellent Remedy. It is a noble cardiac, ſtomachic, calefacient, ſudorific, diuretic, diaphoretic, antiparalytic, antiſpaſmodic, and antepileptic Medicine, where the Diſorders are owing to the cauſes abovementioned. The Credit of this is particularly owing to *Baſil Valentine*, and *Franciſcus Sylvius*, who firſt introduc'd this noble kind of Medicine into Phyſick. The Followers of *Sylvius*, however, by an unſeaſonable uſe of it, have frequently brought it into diſgrace. This inſtance that we have given you now, will ſerve for every thing of this kind; for by ſuſtituting any other aromatic, as Flowers of Lavender, or the like, you will always have a new and excellent Medicine.

PROCESS CXXIV.

A compound aromatic (Sal-Volatile) *volatile Salt.*

APPARATUS.

TAKE of the compound Spirit deſcribed *Proceſs* 72, 24 ounces, put it into a clean Retort, and then add 6 drachms of Salt of Tartar, and 2 ounces of *Sal-Ammoniac* reduc'd to Powder, and mix and diſtill as in the preceding Proceſs. By this means then, there will riſe a white, alcaline, ſpirituous, oily Salt, which muſt be kept for uſe.

USE.

YOU have here another, and indeed better method than the former, of preparing aromatic, oily, volatile Salts, for medicinal purpoſes. This is eaſily underſtood from what has been ſaid *Proc.* 69, 70, 71, 72, 106, 123: For from the conſpiring Vertues of theſe Spirits, are prepared noble Medicines when they are uſed with judgment, which at pleaſure may be varied an infinite number of ways.

PROCESS CXXV.

A particular Preparation of an aromatic (Sal-Volatile Oleoſum) *oily, volatile Salt.*

APPARATUS.

THE Title of this *Proceſs* promiſes a Medicine that by its ſingular Vertue, ſhall anſwer ſome particular phyſical intention. Thus if you want a volatile Salt, to help the excluſion of the *Fœtus*, or provoke the *Lochia*, or *Menſes*, take of the diſtill'd Oil of Juniper, Rue, Savine, and *Arbor Vitæ*, of each 2 drachms, diſſolve them in 20 ounces of alcaliſated Alcohol, ſo as to prepare a Quinteſſence according to *Proceſs* 67, to which add 2 ounces of a pure, dry, volatile, alcaline Salt, and thoroughly ſhake 'em together. By this means then they will be ſufficiently united, if your Salt is but dry, and you will have ſuch a *Sal-Volatile* as you want.

USE.

HERE again you have a third, and pretty good method of preparing an oily, ſpirituous, alcaline Salt. If from Botany and Phyſick, therefore, we knew the particular Vertues of Plants, as we are ſure from Chemiſtry that their ſingular Powers reſide in their Oils, then by this method we might prepare theſe Salts to anſwer the ends propoſed. Thus from Oil of Lavender, Roſemary, and Sweet-marjoram, we have a cephalic *Sal-Volatile*; from the Peel of Oranges, Citrons and Lemons, Bawm, Cinnamon, and Nutmegs, a Cordial, *&c.*

PROCESS CXXVI.

An extemporaneous Sal Volatile Oleoſum.

APPARATUS.

1. TAKE of Salt of Tartar, p. 1. of *Sal Ammoniac*, p. 111. of Aromatics reduced to Powder p. 12. of rectified Spirit of Wine p. 36. mix 'em in a Bolthead, and ſhake 'em together for a conſiderable time. By this means, the alcaline Salt, diſcharg'd from the *Sal-Ammoniac*, will go into the

Alcohol, which will ſwim at top, its Water being attracted into the other Salts. At the ſame time too, the Salts and Spirits will extract the Oil from the Aromatics. The Liquor then, that immediately ſwims at top is the *Sal Volatile* deſired; as was obſerved by the famous *Le Mort.*

2. Take of a diſtill'd aromatic Oil, p. 1. put it into a Cucurbit, add Salt of Tartar p. 3. *Sal-Ammoniac* p. 9. and with a Fire that is but juſt ſufficient to make the Salt riſe, ſublime into a large Head. Keep up this degree of Fire as long as any of the Salt continues to aſcend, then take off the Head, and ſcraping off the Salt with a crooked Knife upon a Paper, or glaz'd Plate, bruiſe it a little, and immediately put it into a clean, dry, cold Veſſel that has a Stopper ground to fit it as nicely as poſſible, and in this manner let it be kept. Thus you have a volatile, oily, ſaponacious Salt, whoſe nature will be determined by that of the Oil you made uſe of. At preſent this is of great note in *England* in hyſterical Diſorders, *&c.*

USE.

THUS then you have a Chemical Hiſtory of theſe volatile, oily Salts, prepar'd indeed after different manners, but pretty nearly of the ſame efficacy, depending upon this volatile *Sapo*, which ariſes from the union of the Spirits of the Alcohol with the *Spiritus Rector*. Theſe now, after the famous *Franciſcus Sylvius* had publiſhed his *Praxis Medica*, An. 1671. *Otto Tachenius* his Treatiſe *De Morborum Principe*, and *Bontekoe* his Works, were all over *Europe* eſteem'd of vaſt conſequence in the Practice of Phyſick. In inflammatory Diſorders, however, in alcalious Scurvies, in a putrid broken *Craſis* of the Humours, and in conſumptive Habits, where the Body is ready, as it were, to diſſolve, they have done great, and often irreparable miſchief. And let the Phyſician be here ſeriouſly cautioned, not to ſuffer their Male Patients of a ſofter make, but their Female ones more particularly, to ſmell ſo frequently to theſe Salts, for hence the olfactory Nerves in the *Membrana Schneideriana*, and others, are deſtroy'd, and the tender Arteries of the Noſe and Lungs are diſpoſed to bring on Hæmorrhages, that are always dangerous, and frequently fatal.

Theſe things then being diſpatch'd, I think I have ſufficiently demonſtrated to you the chemical *Analyſis* of animal Subſtances; and have ſhewn you at the ſame time, various Methods of compounding again their ſeparated parts, for chemical and medicinal Purpoſes. And from what has been ſaid, it appears, that by Putrefaction, and Diſtillation both of putrified and crude animal Bodies, may be procured, 1. A certain, fetidiſh, volatile, fine Spirit, that is mixed with Water, and can ſcarcely be ſeparated from it. 2. A Water, which in purity comes pretty near to elementary Water, except that it will hardly ever quite part with that Spirit. 3. A volatile alcaline Salt. 4. A fine volatile Oil. 5. A thicker Oil. 6. An Earth, which is always found to be the ſame. 7. A Phoſphorus, and in that, perhaps, a heavy Acid. And 8. a Sea-Salt, when that is uſed in the Food of the Animal, otherwiſe not. It is evident now, that theſe Productions, let 'em be depurated and ſeparated ever ſo nicely, and advanced to their greateſt perfection, will not, by being compounded by any Art whatſoever, be reſtored to their original form and vertues, but will compoſe new Bodies, which have ſcarce any thing like 'em in the whole compaſs of Nature. What wonder is it therefore, ſore, that all the parts of Animals ſhould by Putrefaction become volatile and fly off into the Air, or ſhould inſinuate themſelves into the Earth, and that thoſe Particles that were carried aloft, ſhould mix with Rain, Fogs, Dew, Hail and Snow, and with them deſcend again to the Earth, and ſink into its Boſom? And hence why ſhould it ſeem ſtrange, that from theſe again ſhould ariſe the Elements of Vegetables, mutable by their ſeminal Power into their former Nature; and that thus the exhauſted ſtrength of the Earth ſhould be recruited, and it ſhould be rendered capable of producing new Food for Animals, to be converted by their natural Powers into the conſtituent parts of their Bodies? Certainly, whatever the Earth ſpends in the nutrition of Animals and Vegetables, it receives juſt as much from them again, when they come to be deſtroyed, and putrified.

PROCESS CXXVII.

The Phænomena *of Blood, and its* Serum, *with Air, Water, Fire, Salts, acid, alcalious, and ſaline, Spirits, Oils, and Soaps.*

APPARATUS.

1. IN an Air that has any degree of Heat in it, betwixt 32 and 94, good Blood becomes concreted into a ſolid Cake, ſeparates into *Serum* and a red Maſs, and at length totally reſolves, becomes liquid, putrifies, grows volatile, and at laſt flies all off into the Air, except a ſmall fixed part of it. In any degree of cold in the Air, from 32 to 1, and lower, the ſame Blood forms itſelf into a Cake ſooner, freezes, and by freezing has its Water ſeparated from the other Elements, and frozen into a diſtinct Maſs. And whilſt it continues in this frozen ſtate, the Water is continually and ſurpriſingly leſſened, and is in a ſhort time diſſipated into the Air, whilſt the other part, when it comes to thaw, ſoon diſſolves into a ſanious Liquor, putrifies, becomes very volatile, and quickly flies off likewiſe. In an Air that is ſomething more than 120 degrees hot, nothing like which ever happens in our Atmoſphere, it begins to be coagulated into a ſolid Maſs, and ſo on quite to 214: But if the Heat is increaſed farther, it is again diſſolv'd. It admits a certain quantity of Air, divided into its Elements, and diſpoſed betwixt its Particles and no more. If you endeavour by ſhaking to mix more Air with it than what it thus ſpontaneouſly admits, you loſe your labour; for it either repels it, or by inviſcating it, forms it into Bubbles, and ſo retains it ſeparately, without admitting it equably through its Subſtance.

2. In Water from 32 to 94 degrees warm, Blood is at firſt diluted, but at laſt becomes concreted together; as it does in boiling Water immediately. Hence therefore it cannot be retained fluid by Water, unleſs aſſiſted at the ſame time by the Attrition it receives from Circulation; for a briſk motion of it, even in Water, out of the vital Veſſels, can neither preſerve its fluidity, nor render it fluid again when it is once coagulated, as has long appeared by a curious Experiment of the famous *Ruyſch*. If it is put into Water, however, and expoſed to the Air, it will by degrees grow putrid. It is not true, therefore, that either cold or warm Water will of itſelf dilute Blood: But Well-water ſeems to coagulate it more than Rain.

3. Fire, from 33 degrees to 100, makes Blood putrify, reſolves it, ſeparates it, and renders it volatile: A greater degree, quite to 220, coagulates it: A ſtill greater reſolves it again, and renders it putrid immediately.

4. The Acid of *Moſel* and *Rheniſh* Wine, common Vinegar, and diſtill'd Vinegar, dilutes Blood, ſcarcely alters its Colour, and in ſome meaſure preſerves it from Coagulation. The Acid of Sea-Salt coagulates it in an inſtant, and changes it to a greyiſh Colour inclining to black. Spirit of Vitriol and Sulphur in the ſame manner harden it into a Maſs, which is for the moſt part whitiſh. A volatile Alcali ſcarce coagulates it, and preſerves the red Colour. A fix'd Alcali rather diſſolves than condenſes it. A volatile oily Salt, in ſome meaſure coagulates it. *Sal-Ammoniac*, Nitre, *Sal-Gem*, Fountain, and Sea-Salt, and Borax, preſerve and exalt the redneſs, and ſomewhat prevent a Coagulation: As do likewiſe the common Soaps, and the *Sapones Philoſophorum*. The Spirits of Alcohol coagulate it. Oils inviſcate it. In none of theſe Caſes, now, is there any appearance of an Effervеſcence or Ebullition, but the Colour and Conſiſtence are the chief Articles in which we obſerve any alteration. Regenerated Tartar made well, and poured upon Blood, preſerves or exalts its Colour, and beautifully ſecures its fluidity; and of courſe the Liquor of tartariſated Tartar does the ſame; as *Venice* Soap does nearly likewiſe. But *Helmont*'s Tincture of Salt of Tartar, in regard to its Alcohol, which is here exceeding ſtrong, rather coagulates it; tho' at the ſame time, in reſpect of its other part, it prevents the Coagulation's being ſo ſpeedy. The beſt *Sal Volatile Oleoſum*, being mix'd with Blood, without being diluted, on account of its Alcohol, ſomewhat inſpiſſates it rather than attenuates it. A Liquor compounded of Spirit of Vinegar, and a volatile alcaline Salt (*Proceſs* 108.) excellently attenuates, dilutes it, and preſerves its natural Colour.

5. If Metals corroded by Acids, and by this means reduced to a compound Salt, are diſſolv'd in Water till it is perfectly ſaturated, upon being mix'd with Blood, they often immediately make a ſurpriſing alteration in its Colour and Conſiſtence. Vitriol of Iron, prepared in this manner, turns it almoſt black, and coagulates it. Sugar of Lead, made with Vinegar, or Spirit of Nitre, does the ſame; as corroſive ſublimate of Mercury does nearly likewiſe. But Oil of Mercury, which I prepare with the crude Body, and the ſtrongeſt Oil of Vitriol, does the ſame moſt powerfully, and ſooneſt of all. And yet theſe Mercurials given in a ſmall Doſe, moſt certainly, and moſt expeditiouſly diſſolve the whole Maſs of Blood into a thin cadaverous Fluid, which ſoon penetrates and ſweats through all the Emunctories of the Body.

USE.

HENCE then we learn in ſome meaſure the ſenſible effect that the Bodies mentioned will have upon our Blood, by being ſimply mix'd with it. The injecting theſe into the Veins, has likewiſe, by their ſole admixture, produced the very ſame Effects in living Animals. The ſame Bodies, however, taken into the Stomach by the Mouth, have often operated in a vaſtly different manner. There are others likewiſe, which, by the communication of but an infinitely ſmall part of 'em, induce prodigious alterations in the human Body without any ſenſible change of the humours; as we ſee particularly in Poiſons. We muſt not infer, therefore, that becauſe certain Subſtances, upon being mix'd with the Blood out of the Veſſels, have ſuch and ſuch effects, that hence they will have the ſame, if they are taken into the Body, and mixed with it in the courſe of Circulation. But again, from what has been ſaid, we ſee that ſoft Bodies, by being mixed with them, dilute and diſſolve our Humours, rather than acrid ones; and that there can by no means happen any Effervefcences in the vital Blood, whilſt it is contained in its Veſſels; certainly none ſuch as can excite ſo great a force as is neceſſary to overcome ſuch great obſtacles, and give the circulating Fluids ſuch a degree of velocity. *Paracelſus*, therefore, *Van Helmont*, *Des Cartes*, *Sylvius*, and others, have without foundation aſſumed this to explain thoſe things that happen in the Body. Nor does the fatal error of thoſe Phyſicians hence leſs evidently appear, who unreaſonably condemn'd Acids, under a falſe notion of their coagulating the Blood, becauſe they ſaw that this happen'd in Milk. *Hippocrates* certainly was more in the right, who from a ſtrict obſervance of Nature, judg'd Vinegar to be of ſervice in inflammatory Diſeaſes; and yet here the Blood is condens'd. We cannot, however, upon this head, pretend to determine ſafely concerning the efficacy of an Acid upon the Blood, except we firſt ſettle the particular kind we diſpute about. The uſe of foſſil Acids is dangerous, that of Vegetable ones more ſafe: Nay, and thoſe which are look'd upon as Solvents, often prove Coagulents.

CHEMICAL OPERATIONS,

PART III.

Upon FOSSILS.

I. Upon SALTS.

PROCESS CXXVIII.

An Examination of Nitre.

APPARATUS.

1. IN our Operations upon Foſſils, it is proper we ſhould firſt begin with Salts, as theſe are almoſt always neceſſary in the Preparations of the others. And as amongſt all the Foſſil Salts, Nitre, by its origin, comes neareſt to Animals and Vegetables, hence we ſhall treat of that firſt; for it belongs as it were to all the three Kingdoms. And indeed as it is produced from putrified Animals that take in no Sea-Salt with their Food, an Alcali, and Lime, to what claſs can one refer it? But of this I treated ſufficiently, Vol. I. p. 28. This however does not ſeem to be the Nitre, or Νίτρον of the Ancients.

2. If Nitre is put into a clean Crucible, and expoſed to a gentle Fire, it will all melt, without any crackling, and will ſtand like pure Water in the Crucible. And by this means it is not chang'd in its Nature, exhales ſcarcely any thing, but inſinuates itſelf through the Crucible, does not become alcalious, nor acrid, being poured out hardens into ſolid Maſſes, but never flames when it is thus melted, or is ignited, and hence is falſly call'd an inflammable Salt. If you throw a red hot Coal into it, indeed, whilſt it is in this ſtate, it will burſt into Flames immediately with a very great noiſe and agitation, and on this account it has been ſaid to be inflammable. Being taken however into the human Body, it cools it more than any other Salt whatever.

3. In all theſe Veſſels I have ſome very pure Nitre diſſolved in a ſufficient quantity of clean Water, and filtered. Into theſe different Portions of it now, I pour various Acids, and the Liquors do not diſcover any Ebullition, Effervescence, or Agitation, nor grow opake or turbid. To another Portion of this Solution of Nitre, therefore, contained in this Veſſel, I add ſome very pure Oil of Tartar *per Deliquium*, and it immediately, as you ſee, becomes opake and turbid, and preſently forms ſome *Fæces*, which precipitate to the

bottom, from which, if you pour off the Liquor that ſwims at top, it will not afterwards grow turbid by the affuſion of a freſh Alcali. The ſame happens in ſome meaſure too upon pouring in a volatile Alcali. This then is the nature of Nitre.

USE.

HENCE it appears, that Nitre is neither an Alcali nor an Acid, nor of itſelf inflammable; and that of all Salts it melts in the Fire moſt readily.

PROCESS CXXIX.

The Purification and Chryſtallization of Nitre.

APPARATUS.

1. TAKE the common Nitre of the Shops, diſſolve it in 6 times its weight of boiling Water, filter the *Lixivium* whilſt it is boiling hot, put it into a clean cylindrical Veſſel, evaporate it with a clear Fire till a Pellicle appears on the ſurface, and then ſet it by in a cold place, and lay ſome clean Sticks in it, upon which there will be ſoon form'd ſome long, pellucid, hexagonal Priſms. Collect theſe together, put 'em upon a clean earthen Plate, full of Holes that the Water may drain off, and let the Nitre dry of itſelf in the Air.

2. Diſſolve Nitre in 8 times its weight of boiling Water, whilſt it continues boiling hot run it through a filtering Bag, ſoon after drop into it ſome of the pureſt Oil of Tartar *per Deliquium*, mix 'em well together, drop in ſome more, mix 'em again, and ſo proceed till it is no longer diſturb'd by the affuſion of the Alcali. Boil the *Lixivium* for a moment, filter it boiling hot till it becomes exceeding limpid, inſpiſſate it to the formation of a Pellicle, and ſet it by with Sticks in it as before, in a clean cylindrical Veſſel, and in a cold place. By this means, then, you will obtain the ſame ſort of priſmatical Cryſtals as the former. Nor does it appear by any Experiment, that there is the leaſt Alcali adhering to theſe Glebes of Nitre. This Nitre is very pure, nor do I know any method by which it can be rendered more ſo.

3. Take the nitrous *Lixivium* that remains after the firſt Cryſtallization, No. 2. dilute it with an equal quantity of clean Water, boil it up once in a clean Veſſel, filter it boiling hot, evaporate to a Pellicle, ſet it by in a cold place, and it will ſhoot into more good Cryſtals, which muſt be dry'd in the manner directed, and will give you a pure Nitre. If after you have ſeparated theſe, you treat the remaining *Lixivium* in the ſame manner, the event will be again the ſame, and ſo on, till at laſt the remaining pinguious Liquor will refuſe to be form'd into Cryſtals any longer, nor will be dried without great difficulty. And this is not only the caſe with the *Lixivium* of Nitre that has an Alcali mix'd with it in order to purify it, but with that likewiſe, where there is only Nitre diſſolv'd, without any ſuch addition. This laſt is a very ſingular ſaline Liquid, remaining a good while fix'd in the Fire.

USE.

1. BY this method then, we have an exceeding good medicated Nitre, which is very light, and of a particular bitteriſh Taſte, and which being taken into the human Body, wonderfully cools and attenuates the Blood, checks venereal inclinations, and gives the Blood a ſcarlet Colour. But it is chang'd too itſelf in the Body, not remaining immutable there like Sea-Salt, but being converted into ſuch an animal Salt as we have already examin'd. Both the fluid and ſolid parts of Animals being pickled with this Salt, are intirely preſerv'd from Putrefaction, and become exceeding red. In every inflammatory Diſeaſe therefore, where there is phlogiſtic denſity of the Blood, this Salt is the moſt excellent attenuant, and at the ſame time is no ways injurious, either by its too great Weight or Acrimony; nor does it cauſe any conſiderable degree of thirſt, but very happily prevents the alcaleſcence of the human Salt, and the Putrefaction of its Oil. On this account, therefore, Nitre truly deſerves the name of an antiphlogiſtic Salt.

2. In this Proceſs you have an inſtance of the Cryſtallization of Salts, which is the collection of ſaline Elements of the ſame kind into compact Glebes, which in every ſort are of a conſtant and ſingular figure. And this depuration depends upon that Law of Nature, by which, when different Salts are diſſolv'd in Water, and that is reduced to a certain proportion in reſpect of 'em, they begin to acquire a power of uniting together their own proper ſaline Particles, and ſo repel both the Water, and the other Salts. And for this reaſon, if various Salts are mix'd together in Water, and this is by any means drawn off, that always begins to ſhoot firſt that requires the greateſt quantity of Water to keep it diſſolv'd, for the Particles of this firſt begin to aſſociate together, and repel thoſe that will remain diluted in a leſs quantity of Water. If any Salts therefore whatever ſhould require exactly the ſame quantity of Water to diſſolve them, it would be exceeding difficult, when they were once blended together, to ſeparate them from one another, which is done now with a great deal of eaſe and certainty, as we ſee by the Method deſcrib'd, the Nitre is perfectly ſeparated from its Sea-Salt, No. 1. and from the Salt of Tartar, No. 2: For if you take Nitre that is perfectly purified from its Sea-Salt by Cryſtallization, and diſtill it, you will have an acid Spirit that will diſſolve Silver, but will not touch Gold; whereas if a very ſmall portion of Sea-Salt had remain'd mix'd with it, it would have yielded an *Aqua Regia*, and not an *Aqua Fortis*. And again, the ſame Nitre diſſolv'd in Water, and purified by means of a fix'd alcaline Salt, by Cryſtallization alone expells all the Alcali; for in Diſtillation it is converted into ſuch an Acid, as would not have been produc'd, had the fix'd Alcali ſtill remain'd united with it. Here therefore we ſee a wonderful attracting and repelling power, in the action of Salts.

3. Theſe Cryſtals, if they are well prepared, are always pellucid, and exactly of one particular figure. And whilſt they continue in this form, they always conſiſt of Water and Salt united together by a certain Law, and in a certain Proportion. This is evident, for if you put theſe Cryſtals into a clean glaſs Veſſel, and cover it with an Alembic, and expoſe them to the action of the Fire, they conſtantly give out a pure Water; but then at the ſame time

they grow white and opake, and loſing their figure moulder into an irregular Powder. If this Powder, however, is diſſolv'd again in Water, inſpiſſated, and cryſtalliz'd, both the figure and pellucidity will be again reſtored. This therefore they ſhou'd conſider, who talk about the figure of a ſaline Element. Nitre now, that is purified in this manner, remains dry in the Air, nor will eaſily diſſolve with its Moiſture.

PROCESS CXXX.

Nitre and Tartar produce an Alcali in the Fire.

APPARATUS.

I Have here of the pureſt, drieſt Nitre, reduc'd to a very fine Powder, 6 ounces; and of the pureſt, drieſt Cream of Tartar powdered likewiſe, the ſame quantity: Theſe I have taken care to have thoroughly mix'd together, by rubbing them in a clean Mortar, and then had the Powder well dried. An ounce of this Powder then I now put into a very clean, dry, hot braſs Mortar, and apply to it a little bit of a live Coal, upon which it immediately catches into a Flame, with a great noiſe, throwing out Sparks, and diffuſing a very ſtrong Smell, and in a ſhort time leaving a white Maſs that is here and there a little upon the green. As ſoon as ever the Deflagration is over, and whilſt the Maſs continues very hot, I fling in half an ounce more of the ſame Mixture, which deflagrates in a moment, as before, but quicker, as every thing is now become hotter. I proceed then in this manner, till all the Powder is deflagrated, and has produc'd a white Matter a little greeniſh, which is homogeneous, except that there are a few Particles diſperſed up and down, which have not ſufficiently undergone the action of the Fire: Theſe therefore muſt be carefully ſeparated from the other part; and on this account it is better to throw in but a little quantity at once, for then the Fire acts upon the whole more equably.

USE.

HENCE we ſee, that Nitre, which of itſelf is not inflammable (*Proceſs* 128.) when it is mix'd with Tartar, which is oily (*Proceſs* 55.) upon the application of Fire to it, immediately, like Gun-powder, takes Fire with a great noiſe and agitation. And here we learn, that the compound Salt of the Nitre and Tartar, which is evidently acid, by the ſudden action of the flaming Fire, is converted in an inſtant into an Alcali, which the moment before did not by any indication whatever diſcover itſelf, either in the Nitre or the Tartar. Nor indeed, is there any other Method known, by which from a Mixture of Salts not alcaline, but diſtinguiſhing themſelves by a remarkable acidity, a ſtrong fixed Alcali can be ſo ſoon produc'd; for the Salt that is left after this Deflagration is an acrid, ſtrong, fix'd Alcali in every quality, and in every chemical, medicinal, and phyſical Effect. It muſt be confeſs'd indeed, that there is ſome little difference betwixt this and other fix'd Alcali's, as upon pouring Oil of Vitriol upon it, there riſes a Spirit which is ſtill Acid, and has evidently the

Smell of Spirit of Nitre, and ſo demonſtrates, that there is ſtill ſome true Nitre remaining in this Alcali, as will appear farther *Proceſs* 134: But there is but little of it. This therefore is the beſt method of preparing a fix'd Alcali when you want it in haſte. This converſion, however, of Nitre into a fix'd Alcali will not appear ſo ſtrange to a Perſon that is appriz'd, that there is no Nitre produc'd in *Europe*, into which there does not originally enter ſome fix'd Salt of Wood-aſhes. The Salt prepar'd in this manner diſſolves in the Air immediately.

PROCESS CXXXI.

An Alcali from Nitre with live Coals of Wood.

APPARATUS.

TAKE a large ſtrong Crucible, fill it with very dry Powder of Nitre thrown looſely in, and place it where it may ſtand ſufficiently firm. Round it at a diſtance lay a circle of live Coals, which gradually bring nearer and nearer, that thus the Crucible, with the contained Powder, may by degrees be equably heated quite through, for fear, otherwiſe, the Crucible ſhou'd fly: When they are grown thoroughly hot, place as much Fire round 'em as is ſufficient to melt the Nitre intirely, and keep it ſtanding in the Crucible in the form of Water. Then take a little bit of Wood-Coal perfectly red quite thro', and gently lay it upon the Nitre in fuſion, and at reſt; and the very moment this is done, the Coal will burſt into a Flame, will make a Noiſe, and run about the Surface of the melted Nitre, and will be pretty ſoon conſum'd, the Flame then going out, and the Nitre growing quiet again as it was before. As ſoon as ever all is at reſt, throw in ſuch another bit of Coal, and you will have all the ſame *Phænomena* over again. Proceed then in this manner gently, and with care, till the Nitre in the ſame degree of Fire loſes its fluidity, and becomes fix'd, nor will any longer make the Coal flame that is thrown into it, which at length always happens. And when you are near the end of your Work, as the Nitre begins to loſe its fluidity, it will fly about violently, and the Coal that is thrown in will often leap out of the Crucible. When this is the caſe, proceed very patiently, and make your Fire a little ſtronger. When thus at length the Coal will be lighted no longer, let the Fire gradually ſink, and you will have a Maſs in the Crucible, which will have a hollow at the top where the laſt Coal burnt. This Maſs then will be ſolid, heavy, whitiſh, greeniſh, alcaline, and igneous, and will ſpontaneouſly and immediately diſſolve in the Air, for which reaſon you muſt break the Crucible, and take it out whilſt it ſtill continues very hot, and then put it up into a clean glaſs Veſſel, and ſtop it very cloſe.

USE.

1. HERE the Eye perceives that the Nitre is not ſet on fire by the Coal, but that betwixt the inflammable Matter of this, and the melted Nitre, there ariſes a prodigious expulſive and repulſive Motion; for as ſoon as ever the

little Coal is conſum'd, the Nitre appears without any viſible agitation, nor is there any Flame excited again, till upon another bit of Coal's being thrown in the ſame Motion is renewed. Hence the conſumption of the inflammable Matter of the Coal, ſeems to be accelerated by the melted Nitre, whereas it wou'd otherwiſe have been conſumed much more ſlowly. And this accelerated action of the Fire upon the combuſtible Matter ſeems to increaſe the force of its burning; and hence the effect of the Nitre upon combuſtible Bodies, when it is aſſiſted by Fire, ſeems to be only this violent repulſive Motion with which the Matter thrown in, if it is not too ſmall, is driven from the Nitre with an exploſive *Impetus*, after which the whole Body of Nitre ſoon becomes perfectly quiet.

2. The Aſhes of the burnt Vegetable remaining after the deflagration is over, are by that very Motion converted into a fix'd Alcali, and that a pretty pure one, and which of all ſooneſt diſſolves in the Air. But the Alcali produced here in ſo great a quantity does not ariſe only from the burnt Vegetable's leaving a fix'd Salt in its Aſhes, but from the Nitre too which is chang'd at the ſame time. This then is a ſecond Method by which Nitre is converted into an Alcali. And this Alcali is in its nature vaſtly attractive of Moiſture, and hence immediately diſſolves in the Air, and then runs into a very ſtrong, alcaline, igneous Liquid, and leaves a conſiderable quantity of Aſhes. And if this Salt, as ſoon as ever it is made, is diſſolved in pure rain Water, and filter'd, and the *Fæces* that remain in the Bag are waſh'd with ſuch a quantity of Water, that they retain no Salt at all, and are afterwards dried; then if all the *Lixiviums* are inſpiſſated to the thickneſs of Oil of Tartar *per Deliquium*, you will have ſuch a Liquor as the former: And if you then weigh the dry Aſhes, you will hence ſee how much Earth remained after the Operation, and conſequently how much Salt from the burnt Vegetable cou'd concur towards producing this fix'd Alcali; by which means too you will diſcover how much the Nitre contributed to it likewiſe. This generally goes by the name of *Nitrum Alcaliſatum*, or *Nitrum Fixatum*, Alcaliſated, or Fix'd Nitre.

PROCESS CXXXII.

Sal Prunellæ *from Nitre.*

APPARATUS.

1. MELT the pure Nitre of *Proceſs* 129 in a clean Crucible, and as ſoon as ever it is in fuſion pour it out in little thin Cakes upon a clean Marble, and keep theſe, which are of excellent medicinal vertues, under the Title mention'd.

2. Take ſome Flowers of red Poppies, infuſe them in hot Rain-water till it is well colour'd, then ſtrain it, and diſſolve in it the ſame Nitre. Inſpiſſate, and cryſtallize according to Art, and dry the Cryſtals, and you have another *Lapis Prunellæ*, call'd Cryſtal Mineral, which was formerly kept as a great ſecret for a certain Antiphlogiſtic.

3. To 4 ounces of the pureſt Nitre in fuſion in a clean Crucible add 1 ſcruple of the beſt Flowers of Sulphur; upon which there will in an inſtant break out a voilent Flame of the colour of Lightning, which as ſoon as the Sulphur

is conſum'd will immediately go out. Repeat this three or four times, and then let the Nitre be pour'd out into little Cakes, for medicinal uſes, under the title of *Sal Prunellæ*.

USE.

NITRE prepar'd in this manner, agrees perfectly in its Vertues with that of *Proceſs* 129: Nay I prefer that before it, ſo that I think ſo much trouble is by no means neceſſary, purified Nitre anſwering the end intirely. Here we ſee, however, that Nitre, when it is in fuſion, and at reſt in the Fire, has the very ſame effect upon inflammable Sulphur thrown into it as it has upon a live Coal, that is to ſay, it makes it burn away ſooner, and more fiercely. This gave riſe to the Invention of Gun-powder, which conſiſts of Sulphur, Nitre, and Charcoal. This name now of *Sal Prunellæ*, was given it by the *Germans*, on account of its very happily curing an epidemical Camp Fever, attended with a threatning blackiſh *Angina*, which therefore they call'd *die Bräune*. And as they found the *Symphytum petræum* of *Lobellius* us'd with ſucceſs in the ſame caſe, they gave that Herb the name of *Prunella* likewiſe. The Salt prepar'd in this manner is by no means alcalious.

PROCESS CXXXIII.

Sal Polychreſt.

APPARATUS.

1. UPON pure Nitre flowing in a Crucible in the Fire, throw in a little of the pureſt Sulphur, not above a ſcruple at a time, which will deflagrate as we took notice in the preceding Proceſs. When the deflagration is over, throw in ſome more, and ſo proceed till the quantity of Sulphur equals that of the Nitre. When you come towards the end, the Sulphur that's thrown on will deflagrate, but not with that *Impetus* and Brightneſs like Lightning, which appear'd at firſt, but with a ſulphureous Flame. Keep the Matter red hot in the Fire for the ſpace of an hour, and then the Salt will be here and there reddiſh, but otherwiſe greyiſh, or of an Aſh-colour. If you take out the Salt, however, immediately after the deflagration is thus perform'd with an equal quantity of Sulphur, without expoſing it to any farther Fire, it appears to me, I confeſs, to be exactly of the ſame efficacy.

2. Or take of pure dry Nitre, and the beſt Flowers of Sulphur, of each equal parts, rub them together into a fine Powder, heat this cautiouſly, and throw 2 ſcruples of it into a Crucible ſtanding in the Fire and red hot, upon which a deflagration will be excited with a vaſt *Impetus*. When this is over, throw in the ſame quantity again, and ſo proceed, till you have us'd all your Powder. By this means then you will have a Salt at the bottom of the Crucible exactly like the former.

3. Diſſolve the Salt thus prepared in five times as much Water, boiling hot, and in a glaſs Veſſel. Filter it whilſt it continues thus hot, and evaporate till you have got your Salt pure. It will then be of a withiſh Colour, a bitteriſh,

ſulphureous hot Taſte, and of ſuch a Nature as one ſometimes finds a Salt of in natural Baths. It is by no means acid, nor is it alcaline, but is compounded of the Nitre, and ſome part of the Sulphur, which has ſuffered an alteration from the Fire.

USE.

THE Sulphur therefore, which conſiſts of the Acid of Vitriol, and an Oil combined together, has here the greateſt part of its Oil conſum'd with the Nitre, whilſt the acid part of its ſubſtance, though perhaps chang'd by the Fire, together with part of its Oil, becomes intimately united with the Nitre, which is alter'd by the deflagration likewiſe; ſo that you have a third neutral foſſil Salt here prepar'd by the Fire. Hence you ſee that the Nitre, which, when it was deflagrated with the vegetable Coal, was converted into an Alcali, is here with the Sulphur chang'd into a fix'd Salt that is not alcaline, though the deflagration with the Sulphur is ſo long and ſo fierce. The Phyſicians, of *Paris* in particular, having had abundant Experience of the Vertues of this Salt in the human Body have call'd it (*Sal Polychreſtum*) Salt of many Vertues, as it is ſo greatly uſeful, and does good in ſo many different Diſtempers. If a Perſon in health takes 2 drachms of this faſting, diluted in 20 times as much Water, and walks gently after it, drinking 4 or 6 ounces of common Whey, freſh made, it ſometimes gently provokes to vomit, but oftener moves by Stool, and always by Urine: It promotes Sweat too, if it is aſſiſted and determined that way by Heat, Motion, and the Admixture of Sudorifics. It attenuates a cold mucous *Pituita*; as it does likewiſe a condenſed inflammatory one. It opens Obſtructions, corrects a putrifying Bile, incites where the vital Powers are too languid, and ſtimulates gently and ſafely. Hence if it is adminiſtred with Judgment it is of ſervice both in acute and chronical Diſorders. A perfect Tertian it almoſt certainly cures without danger of a return, and without any obſtruction of the *Viſcera*. Quartans too it cures very ſafely, by gradually reſolving the ſtubborn Matter of them, and hence, with ſufficient reaſon, it is greatly eſteemed. If upon ſimple Nitre in fuſion you throw a little *Sal Ammoniac*, it takes Fire likewiſe: And if you repeat this to a ſaturation, it produces a wonderful Salt, which on account of its ſingular nature deſerves examination.

PROCESS CXXXIV.

Glauber's *Spirit of Nitre.*

APPARATUS.

UPON 18 ounces of the pureſt and drieſt Nitre reduc'd to an impalpable Powder, and put into a clean glaſs Retort, pour 6 ounces of the ſtrongeſt Oil of Vitriol, perfectly freed from its Water. Place the Retort immediately in a Sand Furnace, cover it well over, and apply a very large Receiver, which lute on with a Mixture of Lime, Clay, and a little Sand. Upon this there will preſently ariſe a Heat, and a red Fume. Raiſe a moderate Fire, and the Receiver will be fill'd with red Fumes, and a Liquor will diſtill in drops. Gradually increaſe your Fire to the very ſtrongeſt Sand Heat, and then let it ſpontaneouſly abate. When the Heat in the neck of the Retort is gone off, remove the Receiver, taking care at the ſame time to have by you a dry ſtrong glaſs Bottle with a Funnel ſtanding in it. Pour the Liquor out of the Receiver into the Funnel under the Chimney, uſing all poſſible caution, that the red Fumes don't come at your Lungs; for they are acrid, igneous, and exceeding volatile, and diffuſe themſelves about ſurprizingly. As ſoon as ever the Spirit is in the Veſſel, ſtop it cloſe with a glaſs Stopple ground nicely to the Neck. The Receiver may be likewiſe ſecured with a glaſs Stopple, and ſet by for the ſame uſe, and you will find it for ſome Weeks continue fill'd with a red Vapour that is never at reſt. And as for the Liquor in the Bottle, which is of a golden Colour, that too fills the upper empty part with a red Vapour, even for years, as I have myſelf experienced; and whenever you open it, there immediately iſſues out a large quantity of a red, volatile Fume. This Operation is beſt perform'd in the coldeſt Winter ſeaſon, and the prepar'd Liquor ſhou'd be kept in a cold place. When the diſtillation is over, at the bottom of the Retort there remains an exceeding white Salt, that is not acid.

USE.

THE Oil of Vitriol ſcarce touches the Nitre, but there is immediately produced an exceeding acrid, igneous Spirit, that is vaſtly volatile, and perfectly nitrous, and has always the very ſame effect as *Aqua Stygia*, or *Aqua Fortis*, as it is commonly called, and with a fix'd Alcali is recover'd again to true Nitre. And here it is impoſſible to procure any more of that Spirit from the Nitre, whether you make uſe of more or leſs Oil of Vitriol, and then urge with ever ſo great a Sand Heat. All the Nitre, therefore, is not here chang'd from a very fix'd Salt to an exceeding volatile one, from a ſolid to a very fluid one, from a mild to a very acrid one, from a white to a red one, from a neutral to an exceeding acid one, and from an inactive one, to one that is vaſtly mobile, nay never at reſt. That the Liquor now thus produced is a true Spirit of Nitre, appears evident from its Smell, Taſte, Colour, Effect, and red Fumes, and its being capable of being recover'd to Nitre again; nor does it contain any thing at all of the Oil of Vitriol that is made uſe of, as is certain from undoubted Experiments. The other part of the Nitre, therefore, which by this Operation is not render'd volatile, unites with the Oil of Vitriol, and both of 'em become fix'd, and are converted into a white fix'd Salt, that is neither acid, nor alcaline, but a new neutral one, in ſome meaſure reſembling vitriolated Tartar. From theſe conſiderations therefore the moſt famous of the Chemiſts have been induc'd to believe, that Nitre in its firſt original was produc'd from a pure, fix'd, alcaline Salt thoroughly ſaturated with the true proper Spirit of Nitre, ſuch a one as is drawn off here. When the Oil of Vitriol therefore, which is a ſtronger Acid than Spirit of Nitre, comes to be mix'd with the Nitre, then they imagine, that the fix'd alcaline part of the Nitre attracts the very acid Oil of Vitriol, and that this is reciprocally attracted by the Oil, ſo that theſe two become combin'd into one Salt conſiſting of the Alcali of the Nitre and the Oil of Vitriol, whilſt the pure Acid of the Nitre being expell'd from its proper Alcali by the ſuperior power of the Oil of Vitriol, is now ſet at liberty, and appears in its original form of a pure, red, volatile Acid. Hence they impute the whole Effect, obſerv'd here, to a pure ſeparation of parts that actually exiſted before, and not to a production of any thing new by the action of the Fire. And this plauſible Explanation of the Affair ſeems to be farther confirm'd by other Experiments, eſpecially by *Proceſs* 136, 137, 143, 145, 146, 147. If we conſider, however, the production of Nitre from Animals and fix'd alcaline Salts, it ſeems difficult to find any Principle in theſe that in any form bears the leaſt reſemblance to the acid Spirit that we here prepare. And this Opinion ſeems ſtill the more improbable, as the moſt curious Naturaliſts cou'd never diſcover any perfect Nitre that is ſpontaneouſly produc'd; nor did there ever appear, in the whole compaſs of Nature, ſuch an Acid as is prepared by this method. It is ſafer therefore to proceed more ſlowly in our Concluſions from Theory, and ſubmit to the Evidence of Experiments. In the mean time there is no contrivance, that we are at preſent acquainted with, by which a ſtronger and purer Spirit of Nitre can be procur'd than this. This ſort therefore is what we always make uſe of when we want it moſt perfect for Chemical Uſes. The Honour of this valuable Diſcovery is due to *John Rudolphus Glauber*, who, as it was a perfect ſecret, made a conſiderable advantage of it, and at length reveal'd it. Hence you ſee, Gentlemen, what beautiful and uſeful things are found out by applying Bodies to one another, and then expoſing them to the action of Fire: Certainly among all the Experiments that have ever been made in the Chemical Art, this is one of the principal.

PROCESS CXXXV.

Glauber's *ſweet Spirit of Nitre.*

APPARATUS.

1. TAKE 8 parts of Spirit of Wine, reduc'd to the pureſt Alcohol without the addition of any Alcali, put it into a tall Bolthead, pour on it a few drops of *Glauber*'s Spirit of Nitre, wait a little, and ſhake the Veſſel, that they may be perfectly mix'd together. When every thing is quiet drop in a little more, and ſo proceed till you have added 1 part of Spirit of Nitre with reſpect to the Alcohol, always taking care to ſhake them well together after every inſtillation. Digeſt the Liquor for ſome time in the Bolthead, and then diſtill two or three times in a Retort, and by this means you will have a true Spirit of Nitre. *Hoffm. Phyſ. Chem.* p. 128.

2. If you mix in this manner common Spirit of Nitre and Spirit of Wine that is not reduc'd to Alcohol, then as both of 'em are diluted with a good deal of Water, they will not yield ſo generous and truly balſamic a Spirit, nor can one expect ſuch valuable effects from it.

3. But here let me caution you, that I have often experienc'd, myſelf, and demonſtrated to others, the very great danger of mixing the pureſt Alcohol, and the ſtrongeſt Spirit of Nitre in great quantities: For if you put 2 drachms of *Glauber*'s ſtrongeſt Spirit of Nitre into a tall Bolthead, and pour upon it 6 or 7 drachms of the choiceſt Alcohol, there will ariſe a very great Heat, Ebullition, and copious Vapour, and almoſt all the Liquid will ſoon fly off with a very rapid Motion, even out of the talleſt Bolthead; and if it then happens to be

receiv'd into the Lungs, it will bring a Perſon into eminent danger of preſent ſuffocation. In this manner I have loſt the whole myſelf. See the famous Dr. *Slare. Phil. Tran. Abr.* Vol. III. p. 358.

USE.

WHILST the Alcohol and Spirit of Nitre are here uniting together, there is immediately diffuſed a fragrant pleaſant Smell, like that of Southernwood. And at the ſame time there appears a moſt violent efferveſcence, nay one that is ready to burſt into Flame, betwixt the very acid volatile Spirit, and the pure ſubtil Oil, tho' it does not contain the leaſt Alcali. If a Candle is applied to the agitated Vapour, it takes Fire immediately, fills the whole Bolthead with Flame, and in an inſtant ſets every thing on Fire in the moſt dangerous manner. The oftner now the united Liquors are digeſted and diſtill'd, the more accurately they become combin'd together, and yield a more perfect, oily, acid Salt, which poſſeſſes a truly antiſeptic, balſamic, detergent, diſſolving quality, and reſiſts the putrefaction of the Bile. If it is prudently uſed, well diluted, and in ſmall quantity, it very ſoon gives the Teeth an exquiſite whiteneſs, but deſtroys them if us'd too freely. It reſtores an appetite, when the loſs of it is occaſion'd by a mucous *pituita*, a corrupted Bile, or the proper tone of the Stomach's being weaken'd. Among all the Remedies for *Flatus's* it ſtands the firſt. It is ſaid to prevent the Stone, and even to diſſolve the *Calculus* after it is form'd. This was the *Lithontriptic* of the famous *Sylvius*, which was formerly ſo much in eſteem, and ſold ſo dear. It provokes Sweat too and Urine, quenches Thirſt, mends a ſtinking Breath, and is remarkably efficacious in curing the Scurvy. It is taken beſt on an empty Stomach, in Wine, Mead, or Ale, to the quantity of 30 drops at a time, and three or four times a day.

PROCESS CXXXVI.

The Regeneration of Nitre from Proceſs 130, 131, *and* 134.

APPARATUS.

1. TAKE an ounce of Nitre reduc'd to a dry Alcali, according to *Proceſs* 130, 131, diſſolve it in eight times its weight of clean Water, and by letting it ſtand quiet, and filtering it, make the *Lixivium* as clear as poſſible. Put this Liquor whilſt it continues hot into a very clean large glaſs Veſſel, with a narrow Neck, and then drop into it ſucceſſively a few drops of *Glauber*'s Spirit of Nitre. By this means then, upon the falling in of every drop, there will be excited a prodigious efferveſcence, during which keep the Veſſel ſhaking about. When this is over, add a few drops more, and proceed in this manner till the Efferveſcence begins to grow weaker, and then drop only 1 drop at a time into the hot Liquor, and ſhake the Veſſel about very well, and repeat this till upon the inſtillation of the laſt drop there is excited no farther efferveſcence. The point of ſaturation then being perfectly obtain'd, you will have a pellucid Liquor, in which there will begin to be formed ſome long *Striæ*, which are truly nitrous. This Liquor has no Smell at all, but its Taſte is bitteriſh, and exactly

like that of Nitre. Dilute this with Water a little more, boil it for a moment, filter it boiling hot, inſpiſſate it to a Pellicle, and you will ſee it ſhoot into oblong, octogonal, priſmatical, pellucid Cryſtals, which appear to be Nitre by every chemical and phyſical mark. Filter the *Reſiduum* again, inſpiſſate as before, and let it ſhoot into Cryſtals. By this means then you will recover and collect together a true Nitre, which melts eaſily in the Fire, and deflagrates with any inflammable Matter that is thrown into it whilſt it is in fuſion, and evinces its perfect nitrous nature by every quality.

2. If any other pure fix'd Alcali, as that from Tartar or Pot-aſhes, is made uſe of in this Experiment inſtead of the Alcali from Nitre, the event is always the ſame in every reſpect; ſo that in the Nitre regenerated there is not the leaſt ſenſible difference.

USE.

THE great *Boyle* look'd upon this Experiment as of ſo much conſequence, that he thought it worth while to write a whole Treatiſe about it. And certainly it is one of the moſt remarkable in the chemical Art: For hence we learn, that from the moſt acrid, cauſtic Alcali, and Acid, only ſimply mix'd together in a juſt proportion, there is produc'd a neutral Salt, that is mild, cooling, and by no means corroſive; and that an exceeding odorous and volatile acid Spirit, by being attracted into a fix'd Salt, in a moment loſes all its Smell and Volatility, ſo that now it will bear a melting Fire without becoming volatile; whence we eaſily conceive the vaſt attractive power there is betwixt the Acid and the Alcali. But at the very inſtant that this conflict ariſes betwixt them, there is an elaſtic and wonderfully expanſive Air ruſhes forth, which is generated no longer than whilſt this attraction is carrying on, ſo that it ſeems by the colliſion to be ſtruck out of the very Body of the Acid, and the Alcali. We impute this therefore to an attraction, and ſtrong tendency towards each other, not to any repulſion or diſagreement between them; and ſuppoſe this prodigious ſudden motion to ariſe from the Air's being violently expell'd whilſt the Acid and Alcali powerfully attract one another into the moſt intimate union. But from this Operation we ſee farther, that a ſubtil acid Liquor regenerates in an alcaline Body a firm ſolid Salt: That an Alcali, which before ſpontaneouſly diſſolv'd in the Air, and an Acid of Nitre which cou'd ſcarcely by any Art be conſolidated, now they are combin'd together compoſe a Salt, which may be eaſily kept dry in the Air, and which even in Water forms itſelf into ſolid Cryſtals: That the Alcali is determin'd by the Acid into that ſort of compound regenerated Salt, from which the Acid was originally extracted: That hence the Alcali is indifferent towards every Acid, and may be united with them all, but under this Law, that every Acid will regenerate the Mother-Salt from which it was produc'd: That the Alcali, therefore, is of itſelf empty, unfruitful, and feminine, whilſt the Acid is maſculine, impregnates it, generates an offspring of its own kind, and fixes the indetermin'd nature of the former: And laſtly, that the ultimate Elements of Nitre may conſiſt of any fix'd Alcali whatever, perfectly ſaturated with Spirit of Nitre, and that, conſequently, its figure and all its other properties may be produc'd by theſe two united together. But whether now all the Nitre in the World was originally produc'd from this Acid, and fix'd Alcali, firſt exiſting ſeparately, and afterwards combin'd together, I don't pretend to know, but I very much doubt it. That Nitre however may be prepar'd in the manner deſcrib'd, as likewiſe from an Earth that is full of putrified animal Subſtances, and the ſaline Aſhes of Vegetables, or Lime, I am very ſure of: And this is to me ſufficient.

PROCESS CXXXVII.

A Regenerated Nitre that is not fix'd.

APPARATUS.

1. TAKE 3 ounces of a pure, volatile, alcaline Salt prepar'd according to *Proceſs* 106, put it into a large, clean, glaſs Veſſel with a narrow Neck, dilute it with ſix times its weight of Water, and then drop into it ſome of the pureſt Spirit of Nitre. Upon this there will be excited an effervescence, exactly in the ſame manner as in the preceding *Proceſs*. Proceed therefore intirely according to the directions there laid down, till you have accurately obtain'd the point of ſaturation, and you will then perceive, that there will preſently be form'd ſome oblong, priſmatical, octogonal, ſaline *Spicula*, exactly reſembling Nitre.

2. Dilute this compound Liquor with twice its weight of Water, filter, inſpiſſate to a Pellicle with a gentle Fire, ſet it by in a cold place, and it will ſhoot into nitrous Cryſtals. Proceed in this manner till, according to Art, you have reduc'd the whole into ſaline Maſſes, which will be Cryſtals of Nitre, having no Smell, but that bitteriſh cold Taſte which is proper to true Nitre. Theſe melt eaſily in the Fire, but then do not remain fix'd, but fly off. They deflagrate in the Fire too like Nitre with all inflammable Subſtances; and yield a Spirit of Nitre with Oil of Vitriol. Hence therefore they furniſh us with a true Nitre, but a ſemi-volatile one.

USE.

THIS beautiful Experiment likewiſe teaches us all thoſe things which we took notice of in the preceding *Proceſs*. But here we learn farther, that from a volatile alcaline Salt, and a volatile acid Spirit, which of all perhaps of the ſame kind are the moſt odorous, is produc'd a Salt that has no Smell at all: That from cauſtic Bodies ariſe a Salt that is very mild, and exceeding cold: That from the moſt volatile ones is generated a Salt that continues of itſelf at reſt, nor becomes volatile, except in a conſiderable degree of Heat: That a volatile Alcali which is naturally indifferent to all Acids, is determin'd by the nature of the ſaturating Acid, and made to regenerate that Salt from which the Acid was produc'd: That the volatility of this regenerated Salt depends upon the diſpoſition of the concurring Alcali, which being fix'd, the new Salt is fix'd, whereas if it is volatile, that is ſemi-volatile likewiſe: That the nature of this Salt, however, is determin'd by the Acid made uſe of: And laſtly, that we have hence a method of preparing a volatile Nitre, about the diſcovery of which the Chemiſts in all Ages have been ſo greatly ſolicitous. The Vertues now of this ſemi-volatile Nitre, as far as I have been able to judge, are nearly the ſame with thoſe of the common fix'd Nitre, or the fix'd regenerated one, but ſomething milder; the difference betwixt them being pretty much the ſame as that betwixt Sea-Salt and *Sal-Ammoniac*.

PROCESS CXXXVIII.

Glauber's Alcaheſt.

APPARATUS.

TAKE the alcaline Salt of *Proceſs* 131, lay it on a glaſs Plate, and expoſe it to the open Air in a low cold place, that is not duſty. By this means then it will begin ſpontaneouſly to diſſolve, and run into a Liquor, which muſt be carefully pour'd off into a clean glaſs Veſſel. Set the *Reſiduum* again in the ſame place, ſeparate the liquid part as it melts, and ſo proceed till all the Salt is become fluid. There will then remain a good deal of Aſhes, and you will have a Liquor, which being filter'd becomes limpid, alcaline, thickiſh, and exceeding like Oil of Tartar *per deliquium*.

USE.

THIS is that very famous chemical Liquor, which was kept ſuch a ſecret, and was ſo boaſted of by its Author *Glauber*, that he did not ſcruple to ſell it for the true *Alcaheſt*. But we have often ſeen, that when theſe *Arcana* come to be known, they loſe all their reputation. And why mayn't we ſay the ſame thing here? For my own part I confeſs, though I have taken a good deal of pains about it, I never cou'd diſcover any thing particular in it, or that was not in Oil of Tartar *per Deliquium*, in what manner ſoever I made trial of it. But it is more troubleſome to make, you have leſs of it, and it coſts more money; and hence it is valued.

PROCESS CXXXIX.

Nitrated Nitre.

APPARATUS.

TAKE of a *Lixivium* of the pureſt Nitre 8 ounces, drop into it of the beſt Spirit of Nitre 30 drops, inſpiſſate to a pellicle, and reduce to Cryſtals according to Art. Theſe then will be perfectly nitrous in every reſpect, but of an acid Taſte, and go by the name of *Nitrum Nitratum*.

USE.

THIS Proceſs ſerves only to ſhew the method by which ſome complete Salts may be united with the Acid drawn from them into the form of a compound Salt. This now, by adding a greater or leſs quantity of the Spirit, will be more or leſs acid. And the acider it is, the more difficult it is to dry, and the harder to keep dry, almoſt always diſſolving ſpontaneouſly. Nitre acidulated in the manner deſcrib'd is of excellent uſe in burning Fevers, where the tongue is dry and foul, and the patient is thirſty.

PROCESS CXL.

Vegetating Nitre.

APPARATUS.

IF in the preparation of *Glauber*'s Spirit of Nitre *Proceſs* 134, you take 4 parts of Nitre, and 1 of Oil of Vitriol, and after all the Spirit is perfectly drawn off, leave the white dry Salt, that remains at the bottom of the Retort, in the open Air, in a ſhort time its whole ſurface will be covered with a very thick and pretty long Down, which makes it look as if it vegetated, and which I don't remember to have ſeen in other Salts. But when the ſame reſiduary Salt is diſſolved in Water, filter'd, inſpiſſated to a dryneſs, put into a cylindrical Glaſs, and ſo left in the Air, its ſurface often ſeems to ſprout out into the perfect reſemblance of little Plants full of Branches. Theſe all however diſſolve, and fall again, upon the application of Heat to 'em, and the ſurface becomes plain, though upon ſetting the Veſſel again in the free Air they ſhoot out again as before; ſo that theſe Plants ſeem to be reviv'd again from their own Aſhes, concerning which ſome of the Chemical Tribe have given ſuch extraordinary accounts, the foundation of which I am apt to ſuſpect lay in this Art.

USE.

FROM this elegant Experiment, then, we ſee, that the very eaſy Cryſtallization of Nitre gives us an opportunity of repreſenting as it were a kind of Vegetation. Some of the more credulous of the Artiſts indeed have talk'd of a true one, under the Title of a *Palingeneſia Vegetabilis*, but I am of opinion, they never were able to make it appear.

PROCESS CXLI.

Spirit of Nitre with Bole.

APPARATUS.

1. TAKE of pure Nitre reduced to Powder ℔iſs, of common red Bole ℔ivſs, mix them accurately together, and put them into two ſuch earthen long Necks as are deſcrib'd, *Vol.* I. p. 503, taking care that when they lie horizontally in the Furnace deſcribed, p. 513, 514, and with the *Apparatus* there ſufficiently explained, nothing of the Matter ſhall fall into the Necks. The cylindrical Segments and Receivers being luted on, apply a little Fire that they may gradually warm, and then every quarter of an Hour add a little more, till by this gradual increaſe they are perfectly hot quite through. When this is

the caſe, a humid Vapour will begin to come over into the Receiver, upon which gradually increaſe the Fire for two hours, till the Vapour changes its Colour from white to reddiſh. Raiſe your Fire ſtill higher by degrees, till the Vapour comes off quite red, and keep it up for the ſpace of three hours. And laſtly, increaſe your Fire ſo long, till the Veſſels are perfectly red hot, and you can ſee the Matter red hot in the long Neck through the glaſs Receiver, and continue it in this ſtrength for two hours longer. Then ſhut the Furnace, and let the whole cool gradually, and as ſoon as ever the earthen Cylinder that is placed betwixt the long Neck and Receiver is grown cold, very cautiouſly remove the Receiver, keeping as clear as poſſible from the Fumes, and through a glaſs Funnel pour the diſtill'd Liquor into a glaſs Bottle, which muſt be nicely ſecured with a glaſs Stopple, and ſet in a cold place. Thus then you have a very acid, acrid, cauſtic Spirit of Nitre, that exhales very red Fumes, and is exactly like *Glauber*'s Spirit of Nitre, *Proceſs* 134, but never ſo ſtrong. When the Diſtillation has proceeded moſt ſucceſsfully, I have had, with regard to the Nitre made uſe of, $\frac{9}{16}$ or $\frac{1}{2}$ and $\frac{1}{16}$ of ſuch a Spirit.

2. The Bole that then remains at the bottom with the *Reſiduum* of the Nitre, ſtill retains a nitrous Taſte. All this I have boiled in a large quantity of Water, filter'd the Liquor that ſwam at top whilſt it was boiling hot, and then proceeded to boil the *Reſiduum* with freſh Water, and ſo on, till the Water at laſt would fetch out nothing more. All theſe *Lixiviums* I then filtered till they became a limpid Liquor of a nitrous Taſte. This I inſpiſſated, till I reduced it to a ſmall quantity of about the thickneſs of Milk, which had a Taſte that was not very acrid, but lixivious however, and in ſome meaſure alcaleſcent. This Liquor I examin'd, by pouring into it various Acids, and I found it chang'd from the nature of Nitre, and in ſome degree alcalious, but yet not a true Alcali.

3. In this Operation it is neceſſary to take care, that the Turf or other Fuel you throw in during the Diſtillation, is firſt made very hot, for otherwiſe its coldneſs will make the long Necks fly: For this reaſon too, when you open the Door of the Furnace, you muſt ſee that the cold Air don't ruſh in too ſuddenly, for that too will crack the Veſſels. And at the ſame time take care likewiſe, that upon opening the Door, the Flame don't burſt out violently upon you, and burn you, or with the Air be received into your Lungs.

USE.

1. If pure Nitre is put into a glaſs Retort, and plac'd in a ſand Furnace, it melts long before the Glaſs; and when it is heated to ſuch a degree as to flow, it will not grow any hotter, tho' you increaſe the Fire; nor if you keep it there in Fuſion for a long time, will it give out any acid Spirit, but will remain fix'd, exhaling very little. If you treat it too in the ſame manner in a Retort, made of *Heſſian* Earth, and urge it with a very intenſe Fire, there will no acid Spirit come over into the Receiver, but it will inſinuate itſelf through the Pores of the Retort, and be almoſt all loſt.

2. If you intimately mix Nitre with 3 times its weight of Bole, Clay, or Tabacco-pipe Earth, reduc'd to Powder, and then put 'em into a Crucible, and ſet 'em in the Fire, the Nitre will not melt, but will fume and exhale an acid Vapour, and by this be almoſt all pretty ſoon diſſipated into the Air.

3. Hence then it appears, that the Fire acts in a very different manner upon Nitre, when it is prevented from flowing by the interpoſition of 3 times as much of ſome other Matter that will not melt, and is able to heat it to a much greater degree, than when it is in Fuſion by itſelf, and then ſuffers no farther alteration from the Fire. And the change that is by this means effected, conſiſts in the rendering a fix'd Body volatile, a mild one acrid, a ſolid one fluid, and a neutral one very acid, all which is purely owing to the Nitre's being prevented from melting: The ſame alteration now we ſaw before produc'd by the help of Oil of Vitriol, and a ſand Heat, *Proceſs* 134. That theſe things happen in this manner is paſt diſpute; but whether now in the Spirit thus prepared, there is contained any Liquor produced from the Bole itſelf, has been much inquired into, eſpecially as it is aſſerted, that when the Bole has been once uſed for this Operation, it won't anſwer the ſame end again, as you can't then by the help of it draw this Spirit of Nitre. But certainly, the Spirit of Nitre made with Oil of Vitriol *Proceſs* 134, that prepared with the *Calx* of Vitriol, under the Title of *Aqua Fortis*, and that drawn with calcin'd Alum, are abſolutely like this, without almoſt any difference at all; and yet in the Preparation of theſe, there is no admixture of Bole. Let the Experiments therefore on both ſides be carefully obſerved and conſider'd, and 'tis likely time will diſcover which is in the right. *Dabit dies quod hora negat.*

4. But again, ſome of the modern Chemiſts, and thoſe of the firſt rank too, will have it, that Nitre conſiſts of an Alcali, and the proper Acid of Nitre, as we have already taken notice *Proceſs* 134, 136, 137; and the incomparable *Homberg*, by a ſubtil, and very laborious Experiment, has inferr'd the proportion of the Alcali to the Acid, to be as 480 is to 183. But by this Diſtillation, however, the acid Spirit drawn off is but $\frac{9}{16}$ths of the Nitre made uſe of, and from the *Reſiduum* you can ſcarcely procure any thing alcalious, whence it is evident that this Spirit is produced from the Nitre, actually altered by the Fire, and does not ariſe purely from a ſeparation of an Acid and Alcali that exiſted before in the Compound. The wonderful action of the Fire, therefore, has the ſame effect here, as we ſaw Oil of Vitriol had before. As never therefore any true Nitre ſpontaneouſly appeared in Nature, nor ever any of its Spirit has been diſcovered but what was firſt produced from Nitre by the help of Oil of Vitriol, or the action of an intenſe Fire, aſſiſted by ſomewhat to keep the Nitre from melting, hence we are induced to believe, that an acid Spirit of Nitre did never exiſt in the World, before the method of making Nitre, and the Art of drawing a Spirit from it were diſcovered: This at leaſt is as much as we can deduce from Chemical Experiments. Nor cou'd Gunpowder poſſibly be produc'd either by Art or Nature, before this invention of Nitre, even ſuppoſing, that ſetting aſide this one thing we had been acquainted with all Nature beſides.

5. If with Nitre you mix the red Colcothar of Vitriol ſtrongly calcin'd, or calcin'd Alum, in a certain proportion, by this means too the Nitre will be kept from melting in the Fire, and hence will be capable of acquiring a greater degree of Heat, and will yield an acid Spirit in conſiderable quantity with very red Fumes, and will exactly reſemble the true Spirit of Nitre of this *Proceſs* in every character. But beſides the Colcothar's, and the calcin'd Alum's preventing the Nitre's melting by the interpoſition of their parts, we muſt here conſider

likewiſe, that in both of them, notwithſtanding their Calcination, there ſtill lies concealed a very ſtrong Acid, and that in great quantity, call'd Oil of Vitriol, or Alum. This therefore, when it comes to be agitated by the action of the Fire, enters into the Nitre, diſlodges its Spirit, takes poſſeſſion of its place, and when the Spirit is expell'd, produces ſome *Fæces*, in which the Salt, call'd the *Panacea Duplicata*, pretty much reſembles that generated in the Preparation of *Glauber*'s Spirit of Nitre, *Proceſs* 134. Hence therefore ariſe all *Aquæ Fortes*, the production of which depends intirely upon the principles laid down in the *Proceſs* cited. And certainly the Operation of the *Metempſycoſis* of theſe ſaline Spirits is very ſurprizing, whilſt they thus expell one another from their former Seats, and take poſſeſſion of them themſelves, and hence produce a great variety of *Phænomena*, intirely unexpected. But on this Head, ſee *Vol.* I. *p.* 480. *& ſeq.* So far, however, as we have hitherto been able to diſcover, Oil of Sulphur *per Campanam*, Oil of Vitriol, and Oil of Alum, are one and the ſame Acid, which has this property, that it will expel all other known Acids from the Body that retains them, will render them intirely volatile, occupy their place, and after the former acid Spirits are ſeparated, the *Reſiduum* forms a Body of its own nature, that is to ſay, of the genius of this very ſtrong Acid. *Aqua Fortis*, then, is a mere Spirit of Nitre; for Colcothar, by no action of the Fire, continue it ever ſo long, can be quite freed from its Acid, and hence this remaining in the *Caput Mortuum* of the Vitriol and Alum, is attracted into that part of the Nitre which is not convertible into an Acid, is united with it by the Fire, forms with it a new kind of Salt, and entirely expells all the other acid Spirits in the form of *Aqua Fortis*. As for thoſe Chemiſts, therefore, who ſay they can, by a chemical Diſtillation, convert the whole Body of Nitre into a Spirit of Nitre, ſo as from a pound of Nitre to procure the ſame quantity of Spirit by a true Tranſmutation of the whole, I confeſs they ſeem to me to aſſert ſomewhat impoſſible, and abſolutely repugnant to the Chemical Art. This, after a great deal of pains taken upon this Head to come at the truth, I cannot help thinking.

6. The Spirit of Nitre of this *Proceſs*, *Glauber*'s Spirit of the Nitre, and common *Aqua Fortis* rightly prepared, conſtitute a nitrous Acid, which by its red Fumes, and ſingular Smell, diſtinguiſhes itſelf from every other. This Spirit, with a fix'd Alcali regenerates true Nitre, and it diſſolves Silver, and the other Bodies treated of already, *Vol.* I. *p.* 468.

PROCESS CXLII.

The Purification and Chryſtallization of Sea-Salt.

APPARATUS.

TAKE the beſt Sea-Salt of the Shops, diſſolve it in 6 times its weight of the pureſt Rain-water, and filter the Brine boiling hot through a linnen Bag made of thick Cloth till it becomes exceeding limpid. Evaporate $\frac{1}{6}$th part of the Water in a clean glaſs Veſſel, and let the remaining *Lixivium* ſtand cool and quiet for the ſpace of three days, the Veſſel being covered that no Duſt may fall into it. If it depoſites any *Fæces* during this time, let the

Liquor be gently pour'd off from them; if not, it is fit for Chryſtallization. Evaporate then this Brine to a Pellicle, and let it ſtand quiet in a cold place for eight and forty Hours, and it will ſhoot into cubical Cryſtals. Carefully pour off the remaining Brine from the Salt, and let that be dried with a clean Heat, and kept by itſelf; for this is what I chuſe for chemical uſes. Let the Brine that is left be inſpiſſated again, till a Pellicle appears, and you will in the ſame manner have new Cryſtals. And if you repeat this Operation ſufficiently, you will at laſt have a thick, pinguious, rough Liquid, that is not dried without difficulty, and can ſcarcely be reduced to a farther Cryſtallization. If the Salt thus obtain'd is calcin'd by decrepitation, and then melted with a ſtrong Fire, and pour'd out upon a very dry ſmooth Stone, it will diſſolve in the Air, and depoſite terreſtrial *Fæces.* And if the liquid part is again ſeparated from theſe, and is inſpiſſated, calcin'd, pour'd out, and then diſſolved in the Air, as before, and you repeat this a ſufficient number of times, it will at laſt all fly off into the Atmoſphere, and diſappear, as a very ancient Chemical Writer obſerved very juſtly.

USE.

WHAT was ſaid before of Nitre *Proceſs* 129, is confirm'd again by this new Experiment, *viz.* that cryſtallization is the only method by which Salts are procur'd pure and ſimple, an innate vertue, when they are diluted in a certain quantity of Water, uniting together the ſimilar Elements, and ſeparating them from all others; and that the Water's being attracted more by the Elements of one Salt than thoſe of another, is the reaſon that upon inſpiſſation ſome of 'em extricate themſelves, and ſhoot ſooner, others later. Unleſs now Salts are firſt purified in this manner, you will in vain expect to draw ſuch pure Spirits from them as are abſolutely neceſſary for ſome particular purpoſes. Thus for inſtance in the Diſtillation of Nitre, if there happens to be any portion of Sea-Salt among it, you will have an *Aqua Regia* and not an *Aqua Fortis.* And the ſame thing is true, when Nitre happens to be mix'd with Sea-Salt. The Salt thus prepar'd is ſo properly the ſolvent of Gold, that without the aſſiſtance of it in ſome degree Gold can never be diſſolved, except by Metals in fuſion. This Salt is a wonderful Balſam, by means of which all animal and vegetable Subſtances are preſerv'd from putrefaction.

PROCESS CXLIII.

Glauber's *Spirit of Salt.*

APPARATUS.

1. UPON 3 parts of Sea-Salt prepar'd according to the preceding *Proceſs*, and put into a Retort, pour 1 of the beſt Oil of Vitriol. The very moment then they are mix'd together, there riſes from them a volatile, white Vapour, of which take all poſſible care, for it is ſuffocating, and at once may injure the Lungs beyond remedy. Preſently fix on a large cold clean Receiver, and lute the Joint. Upon the application then of the very leaſt Fire, you

will for a good while ſee a ſylveſtrian Spirit fly about with ſuch a violence, that it will perſpire through the Lute with a ſtrong Blaſt, or elſe wou'd burſt the Veſſels. This therefore very gently expel for the ſpace of three or four hours, and then raiſe your Fire a little, and there will come off a Liquor that is not ſo volatile. After eight hours is ſpent in the Diſtillation, urge it to that degree as to make the iron Pot red-hot, and keep up the Fire till the Liquor ceaſes to come over. Let the whole then ſpontaneouſly cool, and when the Neck of the Retort continues hot no longer, remove the Receiver. The diſtill'd Liquor will then ſend out a Fume, of which beware. Pour this into a Bottle, ſtop it very cloſe with a glaſs Stopple, and ſet it in a cold place, for otherwiſe the Veſſel is often burſt by the force of the Vapours. Nay if you open the Bottle after years, there will immediately iſſue out a ſuffocating white Vapour. If you put this Spirit into a Cucurbit under the Chimney, and with a gentle Fire draw it off into a Receiver, there will come off a volatile Spirit, and there will remain a Liquor at the bottom of the Cucurbit, of a yellowiſh Colour inclining to green, that will exhale nothing, but will be more fix'd and quiet, whilſt the acid Liquor in the Receiver will be vaſtly ſuffocating and volatile. This therefore may be kept very cloſe by itſelf.

2. With 3 parts of the pureſt dry Sea-Salt mix in a Retort 2 parts of clean Water, and then add 1 part of the choiceſt Oil of Vitriol, taking care to drop it in gently, leſt from the ſudden Heat that wou'd ariſe from mixing it in too great a quantity at once, the Veſſel ſhou'd be broke. Upon doing this the whole will grow warm. Place your Retort then in a Sand Furnace, apply a large Receiver, and for the firſt four hours diſtil very gently, that the Water that was added may be leiſurely drawn off, for if this riſes very faſt it always cracks the Receiver. This being done, gradually increaſe your Fire, and there will aſcend a Spirit of Sea-Salt, which will diſcover itſelf by ſtreaks in the Receiver uniting together and running down in various convolutions. Then raiſe your Fire freely, urging it till at laſt the iron Pot becomes red hot, and nothing more will come over into the Receiver. The Spirit then will emit no Fumes. When the whole is grown cool, take off the Receiver, and pour out the Spirit, which neither fumes, nor is ſuffocating. If you diſtil this Spirit in a clean Cucurbit with a gentle Fire you will have a Water that is very gratefully acid, and being mix'd with Juleps, is of excellent ſervice in thoſe Diſtempers where it is proper; and there will then remain at the bottom a choice pinguious Spirit of a golden greeniſh Colour.

3. In both theſe caſes there is left at the bottom of the Retort an exceeding white Salt, that is very fix'd, and will not melt without a very ſtrong Fire: But this we ſhall conſider nicely when we come to *Proceſs* 145.

USE.

IT is pretty ſurprizing here, that Oil of Vitriol ſhou'd cauſe ſo volatile a Spirit to riſe from ſuch a very fix'd Salt as Sea-Salt, when it is mix'd with it alone, and yet that this Spirit ſhou'd be immediately fixed by being mix'd with pure Water after it is drawn, and ſhould not be generated when you mix Oil of Vitriol with a ſtrong Brine of Sea-Salt for this Operation, or when you dilute your Oil of Vitriol with Water, before you mix it with the Salt; for by theſe three methods this wonderful volatile Spirit becomes fix'd, and the fatal ſuffocating quality of it is prevented. When the Spirit is thus fixed, and render'd ſalutary, if you expoſe it to a Heat of 100 degrees, it lets go its Water, and at the bottom of the Veſſel there remains a ſtrong, very pinguious, thick, gratefully acid, and fragrant Spirit of a green Colour, which is as good a Spirit of Salt as it is poſſible to make by any Art whatever. But as we obſerved before of the Nitre, ſo here again, there is only a certain portion of the Sea-Salt converted into an acid Spirit, the other part always remaining fix'd with the Oil of Vitriol: And indeed I have ſcarce been able to procure more than one third pure Spirit, free from Water. This Spirit now has the common properties of Acids, and ſome ſingular ones. It is particularly grateful to the Stomach, creates an Appetite, attenuates any mucous Viſcidities there, promotes Digeſtion, reſiſts Putrefaction, and corrects the Bile, when it grows acrid and putrid, or exceeds in quantity. It is of excellent Service too in extirpating a Gangrene of the Gums, Mouth, and Tongue. According to *Van-Helmont*, it prevents the generation of the Stone in the human Body, and diſſolves it when it is form'd. And it eaſes the Strangury that is apt to happen to Perſons in Years. If this Spirit now, when it is very ſtrong is mix'd with three times as much of the choiceſt Alcohol, and they are accurately combin'd by two or three Diſtillations, you then have an oily, acid, balſamic, volatile Salt, that is exceeding fragrant, and of incomparable Vertues. And laſtly, when this Spirit is drawn ſome number of times from Sea-Salt, and render'd very ſtrong and generous, it diſſolves Gold. All things conſider'd therefore, I may venture to ſay, that this Liquor of Sea-Salt cannot be ſufficiently extoll'd. And for this very uſeful Experiment too we are indebted to the induſtrious *Glauber*.

PROCESS CXLIV.

Spirit of Sea-Salt with Bole.

APPARATUS.

1. TAKE of the beſt dry Sea-Salt 6 pound, put it into two earthen Long-necks that hold exactly 3 pounds a piece, ſet them in the Fire, cover them with Tiles that nothing may fall into them, and then ſurround them with Fire firſt at a diſtance, and then gradually nearer and nearer, till at laſt it touches them on every ſide, and lies upon them. By this means then, the Salt will decrepitate ſtrongly, and for a conſiderable time; but when the Long-necks with the Salt are grown red hot, the crackling will ceaſe. When the Fire is mouldered away, you will have an exceeding white Salt, divided into very ſmall Particles, which will decrepitate in the Fire no longer. In this Decrepitation, now, the Salt loſes nearly one quarter part of its weight, but ſetting aſide its not crackling as before, it remains without any alteration, tho' it will melt very eaſily. By this method the Salt is render'd fit for Diſtillation, but if you go to diſtill it before it is decrepitated, when it comes to grow hot, it flies about the Veſſels, and gets into the Receiver, and thus diſturbs the Operation, and ſometimes too breaks the Veſſels. This *Sylveſtrian* crackling Spirit, however, being expell'd by ſuch a Calcination, it will bear the action of the Fire very quietly.

2. Take of this Salt, as ſoon as ever it is decrepitated, 3 pounds, powder it immediately in a hot Mortar, and as ſoon as poſſible mix with it in a large Baſon 10 Pounds of common red Bole, rubbing them well betwixt your Hands for a conſiderable time. Divide the mixture into two equal parts, and put it into two ſuch Long-necks as are deſcribed *Vol.* I. *Pl.* X. taking care that when theſe are diſpoſed horizontally in the Furnace, the Matter ſhall not fall into their Necks. Place the Long-necks in the Furnace, and make up the Cavity round them with Bricks and Mortar, ſo that it ſhall be quite cloſe, and the Mouths of the Veſſels ſhall come out beyond the Furnace Wall. Apply to theſe cylindrical Segments and large Receivers, exactly in the ſame manner as was directed in the Diſtillation of Spirit of Nitre, *Proceſs* 141. This being done, raiſe a gentle Fire, and keep it up for the ſpace of four and twenty hours, that the whole may grow thoroughly hot; then give a pretty ſtrong Fire, and there will riſe a Vapour which will cover the Receiver with a white Cloud, and render it opake, and at the ſame time will appear upon it in form of dewy drops. Continue the Fire in this degree for the ſpace of two or three hours, and then increaſe it, upon which the Receiver generally grows clear again, and diſcovers ſome pinguious ſtreaks running down upon it. As ſoon as theſe appear, you may raiſe your Fire to the higheſt degree, and keep it up for the ſpace of ſix or eight hours more, that the Veſſels may be perfectly red hot. When you ſee no ſtreaks of Spirits run any longer with this intenſe Heat, deſiſt, and leave the whole till it ſpontaneouſly begins to cool. Then carefully remove the Receivers, and pour out the pure Liquor that is collected in them. This then is of an acid Taſte, a grateful fragrant Smell, and a green Colour, and is obtain'd to about the value of 3 ounces, from every 8 ounces of Salt. The Operation being finiſhed, there remains at the bottom of the Long-necks a ſalt Bole. This I have boiled in Water, filter'd the *Lixivium* till it was perfectly limpid, and then inſpiſſated it, and by this means, have procured a conſiderable quantity of a yellow Salt that was not alcalious, but ſaline and ſtyptic, and that ſeemed to be a new kind of Salt. And this I have almoſt always found to be the caſe, and therefore can't help being ſurpriz'd at *Beguinus*, and others, who have aſſerted, that they cou'd convert the whole ſubſtance of the Salt into a very choice Spirit. For my own part, I confeſs, tho' I have uſed the utmoſt care, and urged it with the greateſt degree of Fire kept up for a long time, I never cou'd draw off half ſo much Spirit as I put in Salt, unleſs there was ſome Moiſture either in the Bole or Salt before the Operation. This Diſtillation of Sea-Salt requires a more intenſe Fire than that of Nitre.

USE.

THE quantity of this Spirit, again, makes it evident, that there is but a certain part of the Salt converted into Spirits, and not the whole. In this Diſtillation, there is always towards the end a white Matter inclining to the yellow, that fixes itſelf to the upper part of the Receiver, and has a ſweetiſh, ſaline, ſtyptic Taſte. And this I obſerved to be collected in greater quantity when I mix'd the Salt with Clay inſtead of Bole. This ſeems to me to be produc'd from a pinguious Earth and Salt mix'd together. The Salt procur'd from the *Caput Mortuum* is vaſtly extoll'd by *Van Helmont* for the Preparation of *Butler*'s Stone. The Spirit has the ſame Character and Vertues that are mentioned *Proceſs* 143, and therefore we ſhall not trouble you with a particular account of them, but refer you thither.

PROCESS CXLV.

Glauber's Sal Mirabilis.

APPARATUS.

BREAK the Retort you make uſe of for the Preparation of *Glauber*'s Spirit of Salt, take out the white fixed Salt that remains at the bottom, pound it, put it in a Crucible, and keep it in the Fire till it flows, taking care that none of the Coals fall into it; and then dilute it with hot Water: Or diſſolve the Salt in the Retort, by pouring hot Water upon it. Filter the *Lixivium* almoſt boiling hot, inſpiſſate it to a Pellicle, and ſet it by in a cold place, and by this means it generally hardens into an icy Maſs. Or if it ſhould happen ſtill to continue fluid, it will grow ſolid by pouring it out into another Veſſel. But if that Salt is diſſolved in 6 times as much hot Water, and is then inſpiſſated a little, and ſet by in a large glaſs Veſſel, it will ſhoot into exceeding beautiful Cryſtals, which are pretty large and durable, nor afterwards melt in the Air.

USE.

THE Author of this noble Diſcovery, with a great deal of reaſon called this a *Sal Mirabilis*, not only as it was an intirely new one, but on account likewiſe of its wonderful Effects. I know indeed, ſome of the ſyſtematical Chemiſts aſſert, that this is nothing more than a true vitriolated Tartar, which was known long before *Glauber*'s time. But certainly, the ſame Properties are never found in vitriolated Tartar, as one ſees here, whether you conſider the Figure, Taſte, or Effects: For if this Salt rightly prepared, is reduc'd to Powder, and mixed with 3 times its weight of Vinegar, Ale, Wine, or Water, and ſet by, it makes them freeze. If whilſt it is in Fuſion in a Crucible, you throw into it, by pieces, one quarter part of Antimony, it ſurpriſingly diſſolves it, and has many other Effects, concerning which it is worth your while to conſult *Glauber*, *Boyle*, *Becher*, and *Stahl*, Gentlemen of uncommon penetration in the more abſtruſe Myſteries of the Chemical Art; with whom likewiſe we muſt join the great *Homberg*. In Surgery it is of excellent ſervice againſt Putrefaction and a Gangrene. And internally it produces happy effects, gently ſtimulating, reſolving, and promoting a diſcharge both by Stool and Urine.

PROCESS CXLVI.

The Regeneration of Sea-Salt.

APPARATUS.

DILUTE 4 ounces of Oil of Tartar *per Deliquium*, with 3 times as much clean Water, pour the Solution into a tall large Cucurbit that has a ſmall

Mouth, make it pretty hot, and then drop in either ſome of *Glauber*'s Spirit of Salt, or that prepared with Bole. Upon this there will be excited a prodigious Effervefcence, which being over, ſhake the Veſſel that they may be well mixed together. Then drop in ſome more, and ſo proceed till the Alcali is perfectly ſaturated with the Acid. The point of Saturation being obtain'd, let them ſtand quiet, and when the Liquor has depoſited its *Fæces*, and is grown clear, gently pour it off, filter it, and when it is limpid, inſpiſſate to a Pellicle, and ſet it by in a cold quiet place, and it will ſhoot into Cryſtals, which manifeſtly diſcover themſelves to be Sea-Salt by their Taſte, and every other Property. This therefore we may aſſert is true Sea-Salt. What remains after this firſt Cryſtallization, inſpiſſate to a Pellicle again, and ſet by as before, and you will have more Salt like the former. This Salt is intirely fix'd in the Fire like native Sea-Salt.

USE.

THE vegetable Alcali here, which of itſelf is equally diſpoſed to receive any Acid, is, by being ſaturated with the acid Spirit of Sea-Salt, determined into the particular nature of that Salt alone. Compare this with the iſſue of the Experiment made with Nitre, *Proceſs* 136, and it ſeems greatly to confirm the Doctrine of an Acid, Alcali, and compound Salt. Conſult every thing too that we have mentioned there upon this head, for it all holds good here likewiſe.

PROCESS CXLVII.

The Regeneration of Sal-Ammoniac.

APPARATUS.

TAKE of the alcaline Spirit of *Sal-Ammoniac* 4 ounces, dilute it with twice as much clean cold Water in a tall large Cucurbit with a narrow Mouth, and through a Funnel drop into it a little Spirit of Sea-Salt prepar'd in either manner, taking care that it falls directly upon the Liquor without touching the ſides of the Cucurbit. Upon this there will ariſe a very great effervefcence, which being over, proceed cautiouſly according to the directions frequently given, till you have moſt exactly obtained the point of Saturation. And here there is more than ordinary care required, becauſe if you add more Acid than is neceſſary to ſaturate the Alcali, it will remain united with the regenerated Salt; whereas in the preceding *Proceſs*, if the Acid was predominant in the fix'd Salt, it might be ſeparated from it by the Fire: Here if you endeavour to do the ſame, both the acid and the regenerated Salt, inaſmuch as it is not fix'd, will exhale together. The Saturation then being nicely obtain'd, the Liquor will be exceeding limpid, inodorous, of the ſingular Taſte of *Sal-Ammoniac*, and though you boil it, will not give out any ſaline Vapour. Filter this Liquor, inſpiſſate it to a Pellicle, ſet it by, and there will be form'd in it very fine ſaline Elements, ſomewhat like Down, and exactly reſembling thoſe that are generated in a *Lixivium* of *Sal-Ammoniac*, treated in the ſame manner.

If you inſpiſſate the Liquor, according to Art, till a dry Maſs remains at the bottom, you will have a white Salt that is truly ammoniacal in every reſpect, and with a proper Fire may be ſublim'd into true Flowers of *Sal-Ammoniac.*

USE.

THE volatile alcali of Animals and Vegetables, which of itſelf is equally diſpoſed for the reception of all Acids, is here determined by the Acid of Sea-Salt, into a Sea-Salt, but a ſemi-volatile one. Compare this with *Proceſs* 137, and the Rule obſerved before ſeems to be confirmed, that the Acid determines the Alcali into a Salt of its own nature, whilſt the Alcali is the cauſe of its fixity or volatility. As a volatile Alcali therefore is continually produc'd in great abundance from putrified Animals and Vegetables, hence if there was a Spirit of Sea-Salt diſperſed throughout the world, then wherever theſe two met together they would produce a *Sal-Ammoniac*, whilſt the ſame Spirit meeting with a fixed Salt in the Aſhes of Vegetables, would immediately generate a true fix'd Sea-Salt. But tho' it is eaſy enough to demonſtrate ſuch an Alcali by Experiment, it is vaſtly difficult to make it appear, that there is any ſuch Acid naturally exiſting, unleſs one was acquainted with that *Arcanum* of Mr. *Boyle*, who tells us, that by a ſecret long continued Digeſtion, Sea-Salt may be diſpoſed to part with its Acid by a gentle Heat, before any Water aſcends, and that without mixing any thing elſe with it. *Mech. Qual.* 234.

PROCESS CXLVIII.

Vitriolated Tartar.

APPARATUS.

1. TAKE of the pureſt Oil of Vitriol 3 ounces, dilute it with 3 times the quantity of clean hot Water in a large tall Cucurbit with a narrow Mouth, and pour into it, by drops, Oil of Tartar *per Deliquium* till the Saturation is exactly complete; for otherwiſe, in this caſe there will remain a very prejudicial alcaline, or acid Acrimony. Upon every Inſtillation of the Oil of Tartar, there will be excited a very violent Effervеſcence, and a white Salt will be generated long before the Acid is ſaturated, and will fall to the bottom of the Veſſel. When you have found the point of Saturation, ſhake the Liquor about for a good while, and then if it taſtes neither acid nor alcaline, take a little of it out, heat it, and divide it into two parts, into one of which drop one drop of Oil of Vitriol, into the other a drop of Oil of Tartar *per Deliquium*, and if there then appears no Effervеſcence in either, the Saturation is nicely obtained, which is very neceſſary here for medicinal Purpoſes. But if upon dropping in the Acid an Effervеſcence is excited, it is a proof that the Alcali abounds; and the contrary. The *Equilibrium* being obtained, dilute the Liquor with a good deal of Water boiling hot, that all the Salt may be perfectly diſſolved. Whilſt it continues thus hot, filter it, and then inſpiſſate it, and reduce it to Cryſtals, according to Art, and you will have a white Salt of a middle Taſte, that requires a large quantity of Water to diſſolve it intirely. When you have obtained all

the Cryſtals you can, there will remain a Liquor at the bottom, which will not ſhoot any longer, as happens in Nitre, Sea-Salt, and almoſt every other ſort.

2. Some famous Chemiſts, and among the reſt *Tachenius*, have been of opinion, that the Oil of Vitriol, by being expoſed to ſo intenſe a Fire in the preparing it, carries up along with it ſomewhat metaline, and thus gives this acid Salt a noxious quality that it is not eaſy to free it from afterwards: They contrived therefore to procure the native ſimple Acid from the Vitriol, before it had ſuffered any thing from the Fire, and then united it with the fix'd Salt of Tartar. To this purpoſe therefore they diſſolve the Vitriol in Water, ſo as to obtain a thin Liquor, which being filtered till it becomes pure, they drop into it ſome Oil of Tartar *per Deliquium*, upon which it grows turbid, and the Iron precipitates to the bottom in form of a yellow Ochre. In this manner they proceed, till at laſt, upon dropping in of the Alcali, there is cauſed no farther Precipitation. This point they obſerve very nicely. This being done, the Mixture is ſet by till all the metallic *Fæces* are ſubſided, and then the clear Liquor at top is filtered, inſpiſſated, and cryſtallized as before. By this means then you obtain a vitriolated Tartar without Fire, and, as they imagine, without any ſuſpicion of an acid corroding quality. And indeed, if there is no appearance of a blue or green Colour in the Liquor and the Salt prepared from it, this is ſufficiently pure, but otherwiſe retains ſomething of Copper in it, and therefore is of a hurtful nature.

3. If you treat any pure volatile Alcali in the ſame manner, either with Oil of Vitriol, or Vitriol diſſolved in Water, you will have the ſame kind of Salt, but more penetrating, and ſemi-volatile, whereas the other was ſurpriſingly fix'd. And this Salt, prepare it in what manner you will, is conſiderably heavy and ſolid, and yet at the ſame time is ſufficiently ſoft, and aperient.

USE.

THIS Salt, if it is taken, diluted in Broth or Whey, upon an empty Stomach, is wonderfully aperient, eſpecially if it is aſſiſted with moderate exerciſe; for then, by attenuating, reſiſting putrefaction, and ſtimulating, it ſo powerfully frees the obſtructed *Viſcera*, that it has obtained the name of the *Univerſal Digeſter*: *Tachenius* called it *Vitriolum non-metallicum*. From the 136th, 137th, 146th, 147th, and 148th *Proceſſes* now, it is evident, that thoſe Bodies that are moſt acrid and corroſive when they are alone, *viz.* theſe Alcali's and Acids, upon being mix'd together become perfectly mild. Hence therefore we ſee, that two Liquors that wou'd prove Poiſons were they taken ſeparately, may be drank together without any inconvenience; nay that the ill effects of one of them might be prevented by drinking the other preſently after it. We learn farther too from what has been ſaid, that Water lies wonderfully concealed in Salts, and at laſt may be extricated from them: For the acid Spirit of Nitre contains 60 parts of Water, to 19 of true Acid; Spirit of Salt 52 to 13; and Oil of Vitriol 60 to 37; that is to ſay, ſuppoſing theſe Acids to be as ſtrong as they can poſſibly be made. In the ſecond caſe, therefore, the Water muſt have lain concealed in the decrepitated Sea-Salt in ſo conſiderable a quantity. From the whole then we ſee, that there are but very few ſimple foſſil Acids: For that of Alum, Sulphur, and Vitriol, is the ſame; *Aqua Fortis*, and Spirit of

Nitre, differ very little; and the Spirit of Sea-Salt, *Sal-Gem*, and Fountain-Salt, are perfectly alike.

II. Upon SULPHURS.

PROCESS CXLIX.

The examination of Sulphur.

APPARATUS.

PERFECT Sulphur is found in the Mines in very various forms. Sometimes it is ſmooth and yellow; ſometimes yellow, and almoſt clear like Amber; at others of a gold Colour, approaching to a Ruby, and nearly pellucid; but more frequently of a grey Colour, and opake. If any of theſe ſorts are put into a Crucible, and expoſed to the Fire, they eaſily melt, and whilſt they are in Fuſion appear red and pellucid, but become opake as ſoon as ever they are cold. As ſoon as ever it melts, if it has a communication with the external Air, it very readily takes fire, burns with a blue Flame, and emits a Vapour, which being received into the Lungs ſuffocates all kind of Animals, and thus it intirely conſumes, leaving hardly any *Fæces* behind it. If it is melted, but not ſet on fire, it ſends forth a ſtrong, and as it were, ſub-aromatic Vapour, but not a ſuffocating one. As ſoon as ever it is in Fuſion, part of it flies off into the Air, and if it is kept a good while in this condition without taking fire, it by degrees becomes totally volatile, and diſappears. When it is cold, it is very brittle; when it is melted it hangs together like Pitch: In both forms it refuſes to be mix'd with Water. When it is pure and unmixed, it will by no means diſſolve in Alcohol. If the Powder of it is mix'd with any kind of Acid or Alcali whatever, it does not diſcover the leaſt ſign of an Ebullition or Efferveſcence; ſo that in this reſpect, it does not produce the effects either of an Alcali or Acid. If it is taken crude into the human Body, in a ſmall Doſe, but frequently repeated, it wonderfully purges the firſt paſſages, and at laſt pretty ſtrongly, and then efficaciouſly cures ſome cutaneous Diſeaſes, as well as Diſorders ariſing from Worms, and Mercury. All theſe things now, except the laſt, I here demonſtrate to you by Examples, and they always ſucceed in the ſame manner.

USE.

THUS then we in ſome meaſure underſtand the nature of Sulphur, as it ſpontaneouſly offers itſelf to our examination. And hence we ſee why the Chemiſts have call'd it the Reſin of the Earth, as it comes near to a Reſin in its other properties, though it will not diſſolve either in Spirit of Wine or Alcohol.

PROCESS CL.

Flowers of Sulphur.

APPARATUS.

1. TAKE of the common Sulphur of the Shops 6 ounces, put it into a Cucurbit made of *Heſſian* Earth, fit a large glaſs Head to it, lute the Joints with a Lute made of equal parts of Aſhes and Clay work'd together with Water, place the Cucurbit in a Sand Furnace, taking care that the Sand reaches to the Rim of the Head, and that the Beak of the Head, and the Cucurbit lean forwards a little, that the Moiſture may diſtill into the Receiver. This being done, gradually raiſe your Fire till the Head begins to be clouded with the yellowneſs of the aſcending Sulphur; and there will come over a little Water into the Receiver. Keep up this degree of Heat very nicely, ſo that the Flowers in the Head may not be melted, and yet the Sulphur in the Cucurbit may be ſublim'd. Proceed in this manner for the ſpace of eight hours, at laſt increaſing your Fire to that degree, that if the lower Limb of the Head was but a little hotter, the Flowers in it wou'd melt. By this means then the Sulphur will be ſublim'd into a very fine, ſoft, yellow Matter, almoſt like Wool, which goes by the name of Flowers of Sulphur.

2. This demonſtration is ſufficient for our purpoſe. But theſe Sublimations are commonly made with Furnaces contrived on purpoſe for this work, which have two diſtinct parts, one which contains the Sulphur to be ſublim'd, and under which the Fire is made; the other, which communicates with the former by holes, and is kept cold. Both theſe are very nicely ſtopt up, ſo that no Air ſhall come into either of them. The Sulphur then being acted upon by the Fire in the firſt Partition, is rendered volatile, and propell'd into the ſecond cold one, and is there collected. When the Operation is over, and all is grown cold, the Furnace is open'd, and the Flowers are taken out of one part, whilſt the other is charg'd again with freſh Sulphur. And by this means, as they can ſublime a great quantity at a time, and with little trouble or expence, the common Flowers of Sulphur come very little dearer than the Sulphur itſelf.

USE.

BY this Operation the Sulphur is attenuated and purified, but in other reſpects ſuffers no alteration. Hence it becomes exceeding fit for internal medicinal uſes, as by being thus divided it exerts itſelf in the Body more efficaciouſly. It by this means becomes better likewiſe for external applications in Surgery, eſpecially when it is to be mix'd up with Balſams, Liniments, or Ointments. Thus then we learn the wonderful Nature of Sulphur; for ſublime it ever ſo often, it always remains the ſame, being neither altered, nor becoming fix'd. It can never, therefore, be converted into a Metal, nor ever enter into the compoſition of one; and hence it is not the *Sulphur Philoſophorum:* Nor can that ever be made from it, as this is nothing but an Oil combined with an Acid. So long as the open Air is kept from it whilſt it is in Fuſion, it ſuffers no alteration from the Fire, but as ſoon as ever that has acceſs to it, it very readily takes fire, flames, is altered and ſeparated into different parts. *Paracelſus* orders theſe Flowers to be ſublimed from the red *Calx* of Vitriol, and commends the Flowers thus produced in Ulcers of the Lungs. This therefore I tried, but could not find that they were ſo much better than the common Flowers as he would make them.

PROCESS CLI.

The acid Spirit of Sulphur.

APPARATUS.

1. IN cool moiſt Weather, when there is no Wind, melt ſome of the beſt Flowers of Sulphur in a Gally-pot that is 3 inches deep, and as many broad. When the Sulphur is quite melted, but not on fire, place the Veſſel upon the Hearth under a Chimney that don't ſmoke at all, and then light the Sulphur, covering it immediately with a glaſs Bell, ſo that the Flame ſhall be juſt in the middle of the Glaſs. And here you muſt obſerve to hold the Bell over the Vapour of hot Water before you uſe it, that its internal ſurface may be a little moiſtened; and it muſt be ſet upon three Bricks diſpoſed in a triangular manner, ſo that it ſhall but juſt ſuffer the Flame to burn, for the nearer it comes to the Flame without putting it out, the better. When the Flame is almoſt extinguiſhed, remove the Gally-pot, and have another ready with melted Sulphur, which ſet on fire, and place in its room. And in this manner proceed the whole day. In the Bell then there will be collected, at night in particular as it grows cooler, a heavy acid Vapour, that exhales from the Flame of the burning Sulphur. To this let there be applied a wide mouth'd Glaſs for a Receiver, and let the Bell be plac'd leaning in ſuch a manner, that the Liquor may run into it. By this means then, with a good deal of trouble, and ſome number of Bells, you will procure a Liquor that is gratefully acid, heavy, and ſometimes red, and that is wonderfully fix'd in the Fire, requiring as great a degree of Heat to raiſe it, as Oil of Vitriol. It attracts Water too very powerfully, and hence if it ſtands in an open Veſſel, it gradually increaſes in weight. If all the cautions mention'd are obſerved, the Operation always ſucceeds in this manner.

2. Monſieur *Homberg* however, being tir'd with this tedious method, contriv'd one much eaſier and better, by which may be obtain'd 5 ounces of this Liquor in four and twenty hours. This you have in the *Mem. de l' Ac. Roy. des Sc.* 1703. p. 31. *& ſeq.* and is as follows. Take the biggeſt Receiver you can get made, in which cut a circular hole in the bottom, of 8 or 10 inches wide. In order to do this, with a Thread let down a Bullet from the middle of the Mouth, and on the outſide mark the point with a Diamond where the Bullet reſts at the bottom. Upon this point, as a center, with a pair of Compaſſes, deſcribe a circle with Ink of 10 inches diameter, and when the Ink is dry, with a Diamond cut the circle as deep as you can conveniently, the deeper the better. When this is done, take an iron Ring exactly of the ſame ſize with the circle, which make red hot, and apply to it, and the piece will fly out, and leave the bottom open. With a proper Glue then, round the Neck glue on a piece of Canvas, that has loops to it through which you may paſs ſome lines to keep the Bell equa-

bly ſuſpended. Then take a Gally-pot 6 inches wide, fill this with pure Sulphur, melt it, ſet it on Fire, place it upon a glaz'd earthen Stool ſtanding in a large glaz'd Diſh that riſes in the middle, and then hang the Bell exactly over the middle of the Flame, and ſo near it, that it ſhall juſt ſuffer it to burn and no more. Keep the Sulphur conſtantly burning equably, by continually adding freſh, and removing the Cruſt with an iron Rod, if any is form'd whilſt it is burning, that by this means the Diſtillation may not be interrupted. The ſame cautions too about chuſing a cold, damp, quiet Air, moiſtening the Bell, and the Chimney's not ſmoking, are neceſſary here likewiſe.

USE.

SULPHUR, when it is ſublimed into Flowers, contains neither Earth nor Metal. Being ſet on Fire, when it is in Fuſion, it burns only in its upper ſurface, and then its blue Flame conſiſts of Fire, the oily inflammable part of the Sulphur agitated in that Fire, and the cauſtic foſſil Acid that makes up the other part of the Sulphur, agitated and attenuated likewiſe, and render'd volatile by the violent action of the Flame. And thus the oily combuſtible part is conſum'd by the Fire, and the heavy acid part is diſſipated into the Air, which preſently however unites together again by its weight, as ſoon as it gets beyond the power of the Flame. On this account it is that this Vapour proves ſo fatal; for the acid, which is extremely ſo, and in a very rapid motion, being applied to the Nerves which move the Muſcles that connect together the Interſtices of the cartilaginous Segments of the *Aſpera Arteria*, *Bronchia*, and *Veſiculæ Pulmonales* renders them convuls'd in ſuch a manner, that the Lungs are thrown into a ſhort Cough which by no means relieves them, and become perfectly contracted, ſo that they won't ſuffer themſelves to be expanded by the weight of the Atmoſphere, tho' the *Thorax* is dilated with the moſt laborious inſpiration. If this Vapour is ſhut up with any fermentable Matter, it prevents Fermentation. In every thing that eaſily putrifies, too, it hinders Putrefaction, if it is but ſufficiently applied to it: Hence this Vapour proves a ſecurity againſt peſtilential *Effluvia*, when they are either diſpers'd through the Air, or lie conceal'd in infected Goods. And for this reaſon it is, that the Flame of Sulphur ſet on fire with Nitre, but particularly the Smoke of Gun-powder is ſo very ſerviceable in the time of a Plague; for the acid Vapour of the Nitre and Sulphur corrects the whole Air. The ſame being ſhut up in a cloſe place deſtroys all Animals, even Inſects themſelves. This Spirit of Sulphur call'd Oil of Sulphur *per Campanam*, is the very Oil of Vitriol, which before reſided in the vitriolic Pyrites, and being combin'd with Oil of Coals, conſtituted the Sulphur. This appears to be the caſe by every kind of examination. In Oil of Vitriol however there is ſuppoſed to be a metalline Taint, from which the Spirit of Sulphur, prepar'd from the Flowers, is free. After a great deal of pains, the famous *Homberg* very ſubtily computes, that the Acid makes up nearly one tenth part of the Sulphur, *Mem. de l'Ac. Roy. des Sc.* 1703. p. 31. *& ſeq.* Hence therefore perhaps we ſee the reaſon why Alcohol won't affect this Sulphur? Becauſe its Oil is ſaturated with an Acid. Why the mixing an Alcali with it by Fire in the proportion of 1 to 10 will diſpoſe it to be diſſolv'd by Alcohol? Becauſe the fixing Acid is abſorb'd by the Alcali, and the Oil being ſet at liberty, comes then within the efficacy of the Alcohol. Why Sulphur reſiſts Acids, nor is diſſolv'd by them? Becauſe it is already ſaturated with an Acid, and therefore will admit no more. Why Metals when they are fus'd or calcin'd with Sulphur are corroded by it? Becauſe the Acid of the Sulphur leaving its proper Oil, is attracted more ſtrongly into the Metals, corrodes them, and converts them into a kind of Vitriol. Hence therefore let thoſe Dabblers in Chemiſtry think better of it, who give themſelves a great deal of trouble to find out a method to fix Sulphur; for it is nothing but this foſſil Acid united with a combuſtible Oil. Let them pretend no longer by the help of this to fix the Mercury of Metals: Such heterogeneous Bodies can't enter ſo intimately into one another, nor can they give the weight and durability ſo neceſſary here, nor indeed the malleability or ſimplicity. If this Spirit of Sulphur, when it is render'd pure by ſtanding quiet, is mix'd in ſuch quantity with Juleps, as to render them gratefully acid, it is vaſtly ſerviceable in every inflammatory Diſorder, where there is great Heat, Drought, and a tendency to Putrefaction. *Van Helmont* ſays it will prolong Life to a great Age.

PROCESS CLII.

The ſolution of Sulphur in a fix'd Alcali.

APPARATUS.

TAKE of the pureſt Flowers of Sulphur 9 drachms, melt them in a Crucible, and throw into them of a very dry fix'd Alcali finely powder'd 2 drachms. By this means the Sulphur will immediately acquire a new and particular Smell, and a very red Colour. Stir the Mixture with a Tobacco-pipe, and when it is well melted, and thoroughly mix'd, pour it out upon a cold Marble. The Maſs then will be red, and very brittle, and will diſſolve in Water, and ſoon run in the Air, though the Sulphur reſiſted the action both of Water and Air ſo powerfully before.

USE.

THE fix'd Alcali being render'd active by the Fire, and intimately mix'd with the Sulphur in fuſion, extracts the acid part out of it, and unites it with itſelf, and the Sulphur preſently becomes reſolv'd into its two diſtinct principles. The Oil however does not remain ſeparate, but is cloſely combined with the alcaline Salt, and the Acid, and thus gives riſe to a wonderful kind of Soap, conſiſting of an Oil, an Alcali, and an Acid. The combination therefore of the foſſil Acid with the vegetable Oil, in the compoſition of Sulphur, changes the Oil indeed from its original nature, but the Acid lies conceal'd in it almoſt without any alteration, and therefore, in the reſolution of it, appears again in its proper form. Hence then we ſee the efficacy of a fix'd Alcali in Metallurgy. Sulphur is often mix'd with Metals, and by this admixture produces a brittle Maſs: If to this in a melting Fire you add an Alcali, it immediately lays hold on the Sulphur, and ſeparates it from the metalline Glebe, and a lighter *Sapo* preſently ſwims at top, whilſt the Metal now it is freed from its Sulphur, falls by its proper weight to the bottom of the Crucible, the Alcali having no power upon, nor being able to penetrate into it. And hence, when it is doubtful whether any foſſil Glebe contains Sulphur or not, only rub it with an Alcali, and then melt them together, and the Alcali will diſcover the melted Sulphur, both by its Colour and Smell.

PROCESS CLIII.

The ſolution of Sulphur in a volatile Alcali.

APPARATUS.

WITH the pureſt Flowers of Sulphur mix the ſtrongeſt alcaline Spirit of *Sal-Ammoniac*, Hartſhorn, Blood, Urine, or any thing of the like nature, diſtill, and cohobate, and the Sulphur will be diſſolv'd. Or if you keep them a conſiderable time in a cloſe Veſſel, and frequently ſhake them well together, by this means too you will at length extract a golden Tincture.

USE.

THIS Operation ſerves to demonſtrate the power of a volatile Alcali upon the Acid of Sulphur, and to ſhew us the alteration that is hence effected. But whether or no this Preparation poſſeſſes ſuch medicinal Vertues, eſpecially in Diſorders of the Breaſt, as a very great Chemiſt imagin'd, is much to be doubted.

PROCESS CLIV.

The ſolution of Sulphur in Alcohol of Wine.

APPARATUS.

UPON Sulphur open'd by a fix'd Alcali, according to *Proceſs* 152, and reduced to a very fine Powder in a hot dry Mortar as ſoon as it came hot and dry from the Fire, and then ſtopt up in a dry clean Glaſs, I here pour as much of the pureſt Alcohol as will cover it to the height of five Fingers. And you obſerve now, that by the ſole contact the Alcohol intirely diſſolves the Sulphur, thus prepar'd, into a pinguious thick Liquor of a deep gold Colour, which upon ſhaking becomes ſtill much more ſaturated. When the Liquor has depoſited its *Fæces*, and grown pure by ſtanding, let it be poured off, and freſh Alcohol be added, which will be ting'd likewiſe, and ſo proceed till the Alcohol at laſt is not colour'd at all. Mix all the Tinctures together and you will have a Liquor of a very particular, and not diſagreeable Smell, and of a warm, penetrating, and very aromatic Taſte, and hence of medicinal Vertues anſwerable to theſe Qualities. The *Fæces* that remain at laſt are grey, ſaline, and earthy.

USE.

NATIVE Sulphur is not affected by Alcohol, though you digeſt them together for a great length of Time; and yet when it is once opened by an Alcali it is ſo greedily diſſolved by it that I don't know any ſolution that happens quicker. Hence then we ſee how efficacious an alcaline Salt is in procuring an entrance for Alcohol into Sulphurs. As Sulphur therefore lies conceal'd in a great number of foſſil Glebes, and in metalline ones in particular, but ſtill retains its proper nature, hence it has often happen'd, that this ſimple Tincture of Sulphur has been ſold to Perſons of the greateſt diſtinction for a profound metalline Tincture. Thus I remember a pretended Tincture of Gold ſold at a great price for potable Gold. And the preparation of it was this: Gold was mix'd with crude Antimony, to this Mixture was added in the Fire the Alcali of Tartar, or the *Alcaheſt* of *Glauber*, and then the Compound was pounded and rubb'd well together, which, upon pouring Alcohol upon it, in an hermetical Glaſs yielded a golden Tincture. But this I ſay is nothing more than a ſimple Tincture of Sulphur; for the Gold remains without any alteration, but the Antimony abounding with Sulphur, the Alcali, whilſt the Antimony is in fuſion, attracts this Sulphur, ſeparates it from the metalline Glebe, and opens it, and hence, when the Matter is well rubb'd, and the Alcohol is pour'd upon it, that attracts only the ſulphureous part thus open'd by the Alcali, and leaves both the Gold and metalline part of the Antimony intirely unaffected. And this Obſervation now is of infinite uſe in the examination of many other fictitious Tinctures; for as ſoon as ever it is known that Sulphur is neceſſary for the preparing them, the ſkilful Artiſt will preſently perceive that they ariſe purely from the Sulphur, as the metalline, or, as the Chemiſts call it, the mercurial part, is never affected by a vegetable Alcali. This ſulphureous Tincture furniſhes us with a wonderfully warming Medicine, which breaks the Wind, corrects Acidities, and incites and attenuates any pituitous Matter, if a few drops of it are taken faſting in Mead, *Spaniſh* Wine, or any proper Syrup; but then it turns whitiſh, and goes by the name of *Lac Sulphuris*. But as for its having any ſalutary antiphthiſical Vertue, and being the grand Relief in an Abſceſs of the Lungs, I cou'd never yet diſcover it, though I have obſerved carefully, and heartily wiſh'd for it. With proper regard therefore to the authority of the famous *Willis*, I think it convenient to give you this caution, as in my opinion he has extoll'd it in this Diſtemper greatly beyond what it deſerves.

PROCESS CLV.

Syrup of Sulphur.

APPARATUS.

IF you take a drachm of Sulphur open'd by an Alcali, dilute it with three times the quantity of ſimple Water, and then add twice or three times as much Sugar a little boil'd, you will have a ſulphurated Syrup which will contain the true Vertues of the open'd Sulphur, and may in this form be conveniently applied to medicinal uſes. Or ſhorter, ſimply mix it with Syrup of Liquorice, or any ſuch Syrup in the proportion of 1 to 6.

USE.

WHAT opinion we ought to have of this Mixture in Phyſic, I have already obſerv'd in the Tincture. This Syrup heats, dries, and ſtimulates, which kind of Medicines ſeldom are proper to People afflicted with a Cough, or thoſe in a Conſumption, the *Craſis* of whoſe Blood is quite broken, and who are hence diſpos'd to continual Sweats. But here we learn how ſurprizingly the Vertues of Foſſils may lie conceal'd in almoſt every kind of Body; for if a foſſil Glebe, abounding with Metals and Sulphur, is gently torrified, ground, and then calcin'd with a fix'd Alcali, the alcaline and ſulphureous part will eaſily diſſolve in Water, Syrups, Wine, Alcohol, and other Liquids, and communicate to 'em ſome particular ſecret Vertue, but which ought to be examin'd with a great deal of caution, before it is us'd as a Medicine.

PROCESS CLVI.

The ſolution of Sulphur in an expreſs'd vegetable Oil.

APPARATUS.

TAKE any expreſs'd vegetable Oil, put it into a glaz'd earthen Pan, ſet it over the Fire, and add to it one fourth part of Flowers of Sulphur. When the Oil is heated to that degree as is neceſſary to melt the Sulphur, that will diſſolve, and fall to the bottom of the Oil, in form of a very red ſhining Liquor, and in this degree of Heat they will continue unmix'd for a long while. Increaſe your Fire then, but very cautiouſly leſt the Matter ſhou'd take fire, and at laſt, when the Oil comes to fume, it will become intimately mix'd with the Sulphur, and both of 'em will become opake, and together form a new Body that is perfectly homogeneous. If to this Mixture, whilſt it continues thus to emit Fumes, and is ready to boil, you add more Sulphur, that will readily diſſolve likewiſe, and thus a very large quantity of Sulphur may be diſſolved in ſuch a manner, in a very ſmall one of Oil, as to loſe intirely its former nature.

USE.

THIS is that very famous Balſam of Sulphur of *Helmont*, *Ruland*, and *Boyle*, concerning which you may conſult thoſe Authors. Externally to warm, ſoften, and diſcuſs, they extoll it above any thing; and commend its internal uſe againſt Putrefaction, and Suppurations, particularly of the Lungs and Kidneys. Nay, in this they ſeek the ſecret and only ſufficient help for a pulmonary Conſumption, and aſſert they have found it. For my own part however, I can't think but that, by its pinguious, acrid, indigeſtible, hot Qualities, it muſt do harm to thoſe Lungs, Stomachs, and *Viſcera* that are weak, as well as pall the Appetite, increaſe the Drought, and burn up the Bodies of conſumptive People, which by their Diſtemper are too much dried already. Nor do I ſay this without proper examination of the matter, and therefore wou'd adviſe a very moderate uſe of it, with a careful obſervation of its effect: Certainly it is not without a cauſtic rancidity. Its curing pale, cold, watery, mucous and ſanious external Ulcers with conſiderable ſucceſs, has, I imagine, given occaſion to its being aſſerted, that it will do the ſame thing internally; but this perhaps is done a little too precipitately, as the internal uſe of it raiſes and keeps up a Fever. In a chemical view now we learn from this Experiment, that Sulphur which remains unaffected in Alcohol, which is the ſubtleſt of all Oils, pretty ſoon and almoſt intirely diſſolves in one that is very thick and inert, but is capable at the ſame time of admitting a very great degree of Heat. And this in the Doctrine of *Menſtruums* is a remarkable inſtance, to prove, that the moſt ſubtle and penetrating Body is not capable of effecting what is ſometimes ſoon brought about by another that is thick and inactive. The Chemiſts are apt to wonder, that a great many Foſſils will not yield at all to the ſharpeſt acid Liquors, and yet diſſolve ſucceſsfully in a ſoft inert Oil; But this is not ſurprizing, if we conſider, that Sulphur is capable of reſiſting all acid *Menſtruums*, as it already contains as ſtrong an Acid as any in nature. Hence, therefore, when by boiling a foſſil Glebe in Oil you obtain ſuch a ſulphureous Balſam, this is owing to the Oil's having diſſolv'd the ſulphureous part of the Glebe, and the Lead too, if there was any in it, for this Oil is capable of diſſolving and reducing to a Balſam likewiſe, as will appear, *Proceſs* 177.

PROCESS CLVII.

The ſolution of Sulphur in a diſtill'd vegetable Oil.

APPARATUS.

TAKE of Flowers of Sulphur 1 ounce, put them into a tall Bolthead, pour upon them 6 ounces of æthereal Oil of Turpentine, and boil them together in our wooden Furnace, and the Sulphur at firſt will be melted at the bottom, then part of it will be diſſolved by the Oil with a crackling Noiſe, and at laſt the whole will appear thoroughly mixed. Let it cool then gradually, and great part of the Sulphur will be found concreted at the bottom in form of yellow *Spicula*, with a fluid Balſam at top of it, ſo that the Sulphur appears precipitated in the Balſam with a true Cryſtallization. Nicely pour off all the liquid part from the gold-colour'd ſulphureous Cryſtals, and upon the *Reſiduum* put freſh Oil, and boil as before, and the whole Sulphur will be again diſſolv'd, but then, too, when it comes to be cold you will have more ſulphureous Cryſtals. The Balſam being ſeparated, add again more Oil, and ſo proceed till at laſt the Sulphur will ſhoot into Cryſtals no longer, and then you will find that it will have taken up about ſixteen times its quantity of Oil. Mix together all the Balſams, thus prepar'd, and keep them under the title mention'd. This Operation ought to be perform'd with a great deal of caution, as it is a very dangerous one; for if a Perſon ſhou'd happen to ſtop the Mouth of the Bolthead, the boiling Matter wou'd burſt the Veſſel to pieces with ſuch a violence as can

ſcarcely

ſcarcely be equall'd; a terrible inſtance of which we have given us by the famous *Frederic Hoffman.*

USE.

HENCE therefore it appears, that this thinner, more penetrating, and more pungent diſtill'd Oil, is not capable of diſſolving Sulphur with ſo much eaſe as the ſoft, thick, inert one did in the preceding *Proceſs*; ſo that it looks as if Oils were unfit for this ſolution, in proportion to their greater ſubtlety; as we ſee particularly in Alcohol. And here we obſerve likewiſe, that Sulphur is diſſolved in diſtill'd Oils, as Salt is in Water; that is to ſay, to a determin'd ſaturation, and that it is then diſcharg'd in form of Cryſtals. The exploſive force of this Balſam of Sulphur is the greateſt that we are acquainted with. It conſiſts of the Oil of the Sulphur, the diſſolving Oil of Turpentine, the true Acid of Sulphur *per Campanam*, and ſimple unchangeable Earth. *Mem. de l'Ac. Roy. des Sc.* 1709. p. 46. Externally this Balſam proves an Anodyne to the Nerves, when they are hurt, and is an excellent Remedy for ſanious, ſinuous, moiſt, watery, fiſtulous Ulcers. Internally it is a Diuretic, and Sudorific. It is ſaid to cleanſe and heal internal Ulcers, and hence it is commended in Conſumptions, and Ulcers of the Kidneys, but far more than it deſerves. Some Perſons recommend it too for forcing away Stones; nay and tell us, it is able to diſſolve them. But prudent Phyſicians are beſt pleas'd with thoſe Medicines that work gently, and are cautious about thoſe that are rough. It muſt be confeſs'd however, that a little of this Balſam taken inwardly will quickly give the Urine a violent Smell. On account of the Sulphur that is in them, Tinctures have been drawn from Foſſils by diſtill'd Oils, as we mention'd before of expreſs'd ones, and then have been unjuſtly ſold for Tinctures of Metals. This goes by the name of *Balſamus Sulphuris Terebinthinatus.* Other diſtill'd Oils now may be mix'd with Sulphur in the ſame manner, and then the Balſam is diſtinguiſh'd by the name of the Oil made uſe of. Thus if you uſe Oil of Aniſeed, it is call'd *Balſamus Sulphuris Aniſatus*, and ſo *Succinatus*, *Juniperinus*, &c.

PROCESS CLVIII.

A Soap with Balſam of Sulphur.

APPARATUS.

1. TAKE the Balſam of Sulphur of *Proceſs* 156, dilute it with twice or three times as much of the Oil it was made with, and then with this Mixture make a Soap exactly in the ſame manner as was directed *Proceſs* 73. This is what Dr. *Starkey*, after *Van Helmont*, extolls ſo extravagantly in his *Pyrotechny*.

2. Or take the Balſam of Sulphur of *Proceſs* 157, and with that, inſtead of ſimple Oil, make a terebinthinous Soap in the ſame way you ſaw it done *Proceſs* 74; and then you have the *Sapo Sulphureus Philoſophorum.*

USE.

FROM this *Proceſs* then, we learn the Methods by which both ſimple native Sulphurs, and thoſe that are cloſely combin'd with ſemi-metals, as Antimony, and others, may be brought into union with fix'd alcaline Salts, and with theſe conſtitute a Body which is miſcible with almoſt every Fluid, and is capable of inſinuating itſelf into the Veſſels of the human Body, of mingling with its Humours, and there exerciſing its proper Powers. From theſe Medicines the Followers of *Van Helmont* promiſe very ſingular and ſurpriſing effects, which they imagine can ſcarcely be expected from any thing elſe; for in theſe opened Sulphurs, they think there is a moſt efficacious diſſolving Vertue, diſcovering itſelf by the Smell, (which certainly is a diſagreeable one) and a very penetrating warm Taſte. But I can't help thinking, we have as good Medicines in the Soaps deſcrib'd *Proceſs* 73, 74, and without the fetid ſmell and rancidity that we find in theſe. In a chemical view, however, they have their uſe.

PROCESS CLIX.

Balſam, or Soap, of Sulphur, united with Alcohol.

APPARATUS.

1. WITH the terebinthinous Balſam of Sulphur of *Proceſs* 157, mix 6 times as much of the pureſt Alcohol in a Bolthead, and it will diſſolve it; but when they have ſtood quiet ſome time, the Sulphur will be partly precipitated into ſulphureous Cryſtals, and partly continue diſſolv'd, and give you an alcoholiſated Balſam of Sulphur.

2. Or digeſt the terebinthinous Soap of Sulphur of *Proceſs* 158. *No.* 2. with pure Alcohol, and the Solution will be of an exceeding penetrating Smell and Taſte.

USE.

THIS finiſhes our *Proceſſes* upon Sulphur. But before I quit this ſubject, it is neceſſary I ſhould obſerve to you, that when Sulphur is diſſolv'd in Alcali's, upon being mix'd with an Acid, it precipitates, grows white, ſends forth a moſt noiſome ſtink like that of putrified Excrements, and immediately exhibits very ſurpriſing *Phænomena*, which we obſerve in other Foſſils too, treated in the ſame manner, and which may hence be underſtood. Thus, for inſtance, if into the Golden Tincture of Sulphur of *Proceſs* 154, you drop Vinegar, you have preſently a ſtercoraceous Smell from the precipitated Sulphur. And if you mix Antimony with an Alcali in the Fire, and then draw a Tincture from it with Alcohol, Vinegar dropp'd into this, will have the very ſame effect. This, therefore, will help us to underſtand what we ſhall ſometimes meet with in the *Proceſſes* upon ſulphureous Semi-metals.

PROCESS CLX.

An artificial Sulphur from an Oil and an Acid.

APPARATUS.

TAKE of the pureſt rectified Oil of Turpentine 4 ounces, put this into a clean Retort, and pour upon it of the beſt Oil of Vitriol perfectly dephlegmated 1 ounce, ſhaking them about after every inſtillation that they may be thoroughly mix'd together. By this means then, the Mixture will grow hot, emit Fumes, become red, and diffuſe various kinds of Smells. After they are thus mix'd together, digeſt them for the ſpace of eight days, and then apply a large Receiver, lute the joint well, and diſtill with a ſand Heat. Upon this there will come off a very ſingular oily Liquor, and the Matter at the bottom of the Retort will appear at firſt like a liquid *Bitumen*, but will gradually grow thicker and thicker, and at length become of a pitchy bituminous nature. The Liquor that riſes at the ſame time has a ſuffocating ſulphureous ſtench, vaſtly prejudicial to the Lungs. If you cautiouſly diſtill with ſucceſſive degrees of Heat, there will a true Sulphur aſcend into the Neck of the Retort, which is evidently ſuch, both from its look, and the *Phænomena* it exhibits upon being ſet on fire.

USE.

HENCE then we ſee the artificial Method of preparing *Bitumen* and Sulphur, and that the fix'd Acid of Vitriol, Alum, or Sulphur *per Campanam*, is the *Baſis* of them, and is incombuſtible, whilſt the other part may be any very pure combuſtible Oil. When theſe two are intimately united together, they conſtitute a Sulphur, and when this Compound is ſet on fire, the oily part yields a Flame without any Smoke, whilſt the Acid part being diſtill'd in the Flame of the former, produces a cauſtic, ſuffocating, anti-alcaline, antiſeptic, heavy, acid Vapour, which does not riſe high, and may be collected again by the ſides of a glaſs Bell into the very ſame Oil of Vitriol. An exceeding pure inflammable Oil, therefore, nay ſuch a one as is ſcarce any where elſe to be met with, ſeems to enter into the compoſition of Sulphur, whilſt every thing elſe that is thick, not inflammable, earthy, or ſaline is rejected. And of all the different Acids with which we are furniſh'd, either by Nature or Art, the Acid of Vitriol alone is capable with an Oil of producing Sulphur, and that, wherever it is, let it lie ever ſo much concealed, will, with any inflammable Oil, produce it. Thus vitriolated Tartar, *Glauber*'s *Sal Mirabilis* with Sea-Salt, or with Nitre, Salt of Colcothar, calcin'd Alum, and other Bodies in which there is this Acid, when they are by means of it combin'd with an inflammable Oil, always yield a true Sulphur. Hence therefore this Acid alone is endued with a power of generating Sulphur, tho' all inflammable Oils are properly diſpoſed for it, in conjunction with this Acid; and hence there is never any Sulphur generated, but where this Acid firſt exiſts. From theſe Principles now, we may underſtand the reaſon of an infinite number of *Phænomena* that occur in the Chemical Hiſtory of Foſſils and Metals, and therefore it is abſolutely neceſſary they ſhou'd be treaſur'd up in the Memory. From many others that might be cited here, I'll only mention one Experiment of *Becher*'s. Take *Glauber*'s *Sal Mirabilis*, melt it in the Fire, and whilſt it is in Fuſion, throw into it ſome powder'd Charcoal, and there will be excited a ſulphureous Flame, and at the bottom of the Crucible you will have a reddiſh brown Subſtance. Diſſolve this in Water, and there will precipitate a true ſulphureous Matter. Here then you perceive that the Oil of Vitriol in the *Sal Mirabilis* lays hold on the inflammable Oil of the Coal, and thus produces a Sulphur. In order, therefore, to foreſee the event of any chemical Operation, we ought carefully to conſider, whether there is any Oil of Vitriol, Alum, or Sulphur, either open, or latent in the Bodies mix'd in the Operation, and whether at the ſame time there is any thing inflammable that meets with them; for then you will immediately have a Sulphur, which will afterwards act in its proper capacity.

PROCESS CLXI.

The Preparation of Sulphur with an Acid and Alcohol.

APPARATUS.

TAKE of the pureſt Alcohol of Wine, prepared without any Alcali 8 ounces, put it into a tall glaſs Cucurbit, and pour upon it by drops ſome of the choiceſt Oil of Vitriol, accurately mixing them together, and waiting ſome time after every drop, for otherwiſe there will be excited a prodigious Heat, with very ſuffocating Vapours. Proceed in this manner till you have dropp'd in an ounce of the Oil. The Mixture then will ſend forth a moſt fragrant Smell like that of Southernwood, which will diffuſe itſelf all over the Houſe. But beware of it, for it is of a very ſuffocating quality, a ſmall quantity of it taken into the Lungs exciting a violent Cough; and I am apt to think in a very large one, it wou'd prove inſtantly fatal. The Liquor will be of a reddiſh Colour, which digeſt cloſe for the ſpace of five days in a gentle Heat, and then luting your Veſſels very nicely, diſtill with a ſoft Fire, and there will come off a wonderful ſubtil Spirit, which upon being ſmelt to, is ready to ſtrangle one, and is ſo much the more dangerous, as by its grateful Scent it is apt to tempt one to draw it in more plentifully. Proceed in this gentle Diſtillation till the Mixture begins to grow black, and the laſt part of this Spirit that comes off will be vaſtly fragrant, and then ſomewhat of an Acid will begin to riſe, which was not in the former. Then change the Receiver, and keep up a gentle conſtant Fire, that the Liquor may riſe gradually, for if you raiſe your Fire but for a moment, this wonderful Matter becomes at once ſo flatulent, and rarefies to ſuch a degree, that it runs over into the Receiver, and diſturbs the whole Operation. If you proceed to diſtill in this eaſy manner, there will riſe a fetid watery Liquor, and with it a pure, limpid, heavy one, which will not mix with it. After all this Liquor is drawn off likewiſe, and there does not remain half the quantity made uſe of at firſt, change your Receiver again, and increaſe your Fire by ſucceſſive degrees, till you come to the greateſt. By this means you will have a fetid Liquor too, that will not mix with the preceding heavy one. The Operation being over, at the bottom of the Veſſel you will have a black, brittle, acid Matter, which is not inflammable, but otherwiſe in ſome meaſure approaches to Sulphur. By this method then you have three diſtinct Liquors from this Mixture of Alcohol and Oil of Vitriol, with a ſulphureous ſuffocating Vapour, and ſome remaining fixed *Fæces*, of a perfectly ſingular Nature.

USE.

THIS very ſtrong foſſil Acid, by being ſimply mix'd with that exceeding ſubtil Oil Alcohol, produces ſuch a prodigious Heat, that if they are imprudently mix'd together, they are ready to burſt into Flames, with a very conſiderable Efferveſcence. The very inſtant they are mix'd, they ſend forth a very fragrant Smell, which diffuſes itſelf about to a great diſtance; but by a long Digeſtion they acquire a fetid Smell like that of Garlic. The pleaſant Smell however carries along with it a ſuffocating Acid. Hence there is ſeparated from this Mixture by Diſtillation, firſt a ſpirituous, fragrant, ſuffocating, inflammable, acidiſh Liquor, tho' the Oil of Vitriol was ſo fix'd juſt before, nor by any means of a ſweet Smell; in the ſecond place a fetid ſulphureous Liquor, that is neither inflammable, nor acid, but aqueous, tho' there was not much Water to be diſcovered, either in the Oil of Vitriol or the Alcohol; and thirdly, a limpid heavy Liquor, that has both a grateful, aromatic Smell and Taſte, which will not ſuffer itſelf to be mixed with the former, but may be diluted with Alcohol of Wine, and then will extract ſomewhat of Tincture from calcined Gold. Hence this is look'd upon as the *Oleum Vitrioli Philoſophorum:* Certainly it is a ſweet Oil of Vitriol; concerning which conſult *Iſaac Hollandus*, *Conrad Geſner*, in *Euonymo*, *Boyle*'s *Original Forms*, p. 282 to 290, but particularly *Hoffman*'s *Diſſ. Chem. Phyſ.* from p. 173, to 180. The remaining black *Fæces* being diluted with Water, almoſt return again to an acid Oil of Vitriol. Hence then you ſee how many and what unexpected *Phænomena* ariſe from this Combination. Is this the *Spiritus Vini Philoſophorum*, which by its grateful Fragrance draws Perſons to it whilſt it is making, concerning which *Lully* wrote? Is it the fragrant *Spiritus Vitrioli Dulcis* of *Paracelſus*, which he ſo extolls in Epilepſies? And is it with this that *Paracelſus*'s Tincture of Gold is drawn, ſo as to make an *Aurum Potabile*, digeſted, as he ſays, in the Stomach of an Oſtrich? This Operation certainly ſhould excite the curious to examine, but with prudence, whether any of theſe great *Arcana* lie concealed here. In the mean time we ſee that abſolute Sulphur is not generated by this means, tho' there is an appearance of ſome of its Properties.

III. Upon METALS.

PROCESS CLXII.

Vitriol of Iron.

APPARATUS.

1. TAKE ſome pure Rain-water, put it into a clean Urinal, and drop into it $\frac{1}{8}$th as much of the choiceſt Oil of Vitriol, continually ſtirring them about, in order to mix them thoroughly together. Into this pure acid Liquor throw a ſmall portion of the cleaneſt Filings of Iron that are not ruſty, and there will be excited a prodigious Ebullition, and the Liquor will grow hot, and become opake, and of a greyiſh Colour. At the ſame time too there will riſe a perfect foſſil Vapour, of a very ſingular Smell, in which, however, there is ſomewhat like that of Garlic. When the Efferveſcence is over, and the Solution is compleat, throw in ſome more Filings, and ſo proceed, till at laſt ſome part remains undiſſolv'd at the bottom of the Veſſel. Let the Liquor ſtand quiet, depoſite its *Fæces*, and become pure, and it will be of a greeniſh Colour, and have a ſweetiſh ſtyptic Taſte.

2. The pure Liquor that ſwims at top being filter'd through a paper Bag, becomes exceeding limpid, and of a beautiful green Colour. Let this be put into a very clean Urinal, and be inſpiſſated with a gentle Fire to the appearance of a Pellicle, and then let the Veſſel be ſet in a ſtill, cold, ſubterraneous place, and in a ſhort time there will be formed at the bottom ſome pretty pellucid Cryſtals of a green Colour like an Emerald. If theſe are ſeparated from the liquid part, and are gently dried upon a Paper in a dry, clean, warm Air, and are then put up into a Vial, they will continue in this form a long time. Inſpiſſate the remaining Liquor, and ſet it by as before, and it will again ſhoot into freſh Cryſtals, and ſo on till the whole is almoſt reduced to a Vitriol, tho' the firſt Cryſtals will be always the fineſt.

USE.

THE Metal of the Iron attracts the foſſil Acid from the Oil of Vitriol diluted in the Water, exactly as the Alcali did in the *Tartarus Vitriolatus*, *Proceſs* 148. In this reſpect therefore Iron agrees with an Alcali. Hence the Iron being by this means united with the Acid, it becomes ſoluble in Water, and thus the Compound acquires the diſpoſition of a metallic Salt. This Vitriol, now, conſiſts of Water, a Metal, and an Acid, combin'd together in a certain proportion, which being preſerv'd, the Maſs ſo long continues equably beautiful and pellucid; but as ſoon as ever the Water only is ſeparated by a ſomewhat greater degree of it, it immediately becomes opake, and loſing its agreeable green Colour, acquires a greyiſh one. In this reſpect therefore again it reſembles the Cryſtals of Salts, and hence the Chemiſts have call'd it (*Sal-Martis*) Salt of Iron. Some however have thought it ought rather to be call'd a Mageſtery of Iron, inaſmuch as the whole ſubſtance of the Iron becomes concreted with its ſolvent into a Maſs that is perfectly homogeneous. It has obtain'd the name too of Vitriol of Iron, as it perfectly reſembles native foſſil *Calcanthum*, in every property. Hence then we ſee the manner in which hard Metals, by union with an Acid, become, like Salts, diſſoluble in Water, and by this means potable. Then too they acquire a new, metallic, ſaline Taſte, and very particular Vertues, with regard to the human Body. If this Salt of Iron is diluted with a hundred times as much pure Water, and is drank upon an empty Stomach to the quantity of 12 ounces, the Patient walking gently after it, it opens, relaxes, purges, promotes a diſcharge by Urine, deſtroys Worms, brings them away, renders the Excrements very black, or like Clay, and ſtrengthens the Fibres, and hence cures a great many, and thoſe very different Diſeaſes. On account, now, of their Taſte, Smell and Colour, and their tinging the Excrements, a great many Perſons have been of opinion, that the medicinal chalybeate Water were produced by Nature too, in the ſame manner; eſpecially as both theſe Liquors, if they are expoſed to the Air, let fall ſome yellow *Fæces*, call'd Ochre: But this error the famous *Hoffman* has judiciouſly corrected, by ſome Experiments which he has given us in that noble Treatiſe *De Aquis Medicatis*. It is neceſſary however to take Notice, that this Salt of Iron, by meeting with any alcaleſcent or putrid Subſtances, will have its Acid abſorb'd, and by this means be converted into an aſtringent, heavy, inert, metalline Matter, and will then occaſion the worſt kind of Obſtructions; and hence in putrid Fevers it proves prejudicial. But experience evinces, that Filings of Iron, being taken by the female Sex, when they are weak, and diſpos'd to breed Acids, by their meeting with the Acids cauſe *Ructus*'s that have a Taſte like that of Garlick or rotten Eggs, the Stools at the ſame time being almoſt black, and the Body being reſtor'd again to its proper Heat; and then it is found that the Filings of Iron taken in Powder do more ſervice than the moſt laborious chemical preparation of it. Hence we learn, that in thoſe Habits of Body where Acids are predominant, it does good, though it proves hurtful in hot bilious ones. But from the conſideration of this Experiment we underſtand too the origin of all the green metalline Vitriol in the World; for it is Iron corroded by a vitriolic foſſil Acid. And laſtly, upon this Experiment depends the preparation of almoſt all ſorts of Ink.

PROCESS CLXIII.

Ludovici's *Vitriol of Iron with Tartar.*

APPARATUS.

1. TAKE of Vitriol of Iron, not acid, but perfectly ſaturated, 1 part, of Cryſtals of Tartar 4 parts, and of Rain-water 20 parts: Boil theſe together in a glaſs Veſſel, keeping them frequently ſtirring with a Stick, till you have reduced them to a thick greyiſh Maſs, almoſt of a ſolid conſiſtence, which you muſt take care is not burnt in the leaſt degree. Put this Matter into a tall Bolthead, pour upon it as much common Spirit of Wine as will cover it to the height of four inches, and boil them for one or two hours, by which

means you will have a red Liquor at top. When the whole is grown cold pour off the pure Liquor, and filter it. Upon the *Reſiduum* put freſh Spirit as before, and treat it in the ſame manner, and repeat this as long as the Matter will give out any Colour. The Tinctures being all filter'd, mix them together, and you have *Ludovici*'s medicated Tincture of Iron.

2. If this Tincture is diſtill'd to the appearance of a Pellicle, the Spirit is drawn off, and the Tartar forms itſelf with the Salt of Iron into medicinal Cryſtals. And if you take what remains after you have drawn your Tincture with the Spirit, and boil it ſtrongly with ten times as much Water, and filter it through a woollen Bag boiling hot till it becomes limpid, and then proceed to pour on more Water, boil, and filter, and ſo on till all the matter is diſſolv'd and depurated by running through the Bag, then if the Liquor is inſpiſſated to a Pellicle, and ſet in a cold place, you will here again have *Ludovici*'s *Tartarus Martialis Aperiens*, which muſt be kept in a Vial well ſtopt.

USE.

THE Phyſicians obſerving that the excellent medicinal Vertues of Iron, in ſome meaſure explain'd in the preceding *Proceſs*, retain'd their efficacy as long as the Iron continued diſſolv'd by a gentle Acid, but were deſtroy'd, nay and the Iron became precipitated too into a hurtful *Calx*, as ſoon as ever it met with an Alcali; hence they prudently combin'd Salt of Iron with a vegetable Acid, in hopes that in this ſaline form it wou'd continue and act in the human Body with greater conſtancy. And this is the reaſon of uniting Salt of Iron with the oily, vegetable, acid Salt of Tartar, *viz.* that it might not eaſily precipitate in the Body into an aſtringent *Crocus*, or cineritious Matter. This Preparation opens, attenuates, corroborates, ſtimulates, and moderately evacuates, both by Stool and Urine. Hence in leucophlegmatic, ſcorbutic, icterical, hypochondriacal, and hyſterical caſes, where there is a laxity and weakneſs from an *Inertia*, it proves of ſervice, as likewiſe in the Rickets, and Worms. If the Tincture is drank faſting, to the quantity of 3 drachms, diluted in 6 times as much Water, and divided into three doſes, taking after each of 'em 4 ounces of very thin Whey, and walking gently ſo as not to ſweat, and this is proſecuted for nine days ſucceſſively, it has often a very good Effect. To rickety Children, and thoſe that are troubled with Worms, and are hence fallen into a bad habit of Body, a few drops of this Ticture given in Honey, or a proper Syrup are ſufficient. A drachm of the *Tartarus Martialis* taken in a Morning faſting will anſwer the ſame purpoſes as 3 of the Tincture. Hence we ſee the method of converting Metals into various medicinal forms, in which they muſt then be uſed with judgment. It is a very good ſign that theſe Medicines have a proper Effect, when they gently move by Stool, and the *Fæces* are black, or greyiſh.

PROCESS CLXIV.

A white, grey, and red Calx *of Vitriol of Iron.*

APPARATUS.

1. TAKE of the beſt dry Vitriol of Iron half an ounce, reduce it to a very fine Powder in a glaſs Mortar, and lay it upon a glaſs Plate, in a Heat of 150 degrees, keeping it continually ſtirring with a Stick, by which means there will exhale ſomewhat of a watery Vapour, and the Powder will grow white like Flower, and have an inky, ſweet, ſtyptic Taſte: This is the white *Calx.*

2. If this *Calx* is expoſed to a ſtronger Fire, one for inſtance of 300 degrees, it will acquire a greyer Colour, and will have a rough Taſte.

3. And if this ſecond *Calx* is uſtulated in a Crucible in an open Fire, it then grows yellow and red, and at laſt you have a purple red Powder, which has a rough and ſomewhat cauſtic Taſte. And here the ſtronger the Fire is, and the longer it is in it, the more in proportion are theſe laſt qualities heighten'd, ſo that at length it becomes nearly cauſtic.

USE.

HENCE we ſee that Vitriols, or metallic Salts loſe their pellucid form as ſoon as ever their Water is ſeparated from them, and then moulder as it were into Aſhes, on which account this Operation is call'd Calcination, and the Matter thus produc'd is call'd a *Calx.* And when they come to be expos'd to a ſtrong degree of Fire, they then loſe their ſolubility in Water, as in the third *Calx* is always found to hold true. The firſt *Calx* is eſteem'd in Medicine, as it retains its native Vertues, and may now be eaſily mix'd with Sugar, and ſo given to Children. Some Perſons have imagin'd, that the Acid, if it ſhou'd happen to predominate, wou'd be expell'd by this calcination; but certainly Oil of Vitriol won't ſuffer itſelf to be ſeparated by ſo ſmall a degree of Heat. The ſecond too has the ſame Vertues, but is ſomewhat more aſtringent, and is leſs ſoluble in Water. But the third, as it will not diſſolve in the human Body, and yet has a cauſtic quality, can ſcarcely ever be internally adminiſter'd with ſafety. Externally, however, it is of excellent ſervice in eating down and then incarning the Lips of ſtubborn Ulcers, and in ſtopping Fluxes of Blood, *Serum,* and Lymph. If this red *Calx* of Vitriol of Iron is calcin'd for a good while with an intenſe Fire, and then boil'd in Water, it gives the Water a vitriolic acidity, and if you then decant the Water, put on freſh, boil and pour off, and ſo on, till the laſt Water comes off as inſipid as it was put on, there will then remain a red, inſipid, aſtringent Powder, which goes by the name of *Crocus Martis Aſtringens,* containing the Body of the Iron calcin'd by the Acid, and Fire, and hence generally made uſe of as an aſtringent. The acid Waters being inſpiſſated to a Pellicle, and then ſet by, yield ſomewhat of a vitriolic Salt.

PROCESS CLXV.

A Liquor of Iron per Deliquium.

APPARATUS.

IF the red *Calx* of the preceding *Proceſs* ſtrongly calcin'd, but not waſhed, is reduc'd to powder, put into a glaſs Plate, and expos'd to a damp Air, it grows moiſt and is at laſt converted into a kind of liquidiſh red Matter, which may be call'd Oil of Iron *per Deliquium.*

USE.

IN Vitriol of Iron is contain'd an exceeding ſtrong foſſil Acid, together with Water. When the Water is ſeparated by the Fire, there remains only the metalline part, and the pure Acid, which is now in a dry form, and being in its Nature averſed to being kept ſo, attracts the Water out of the Air: This is the true reaſon of this *Phænomenon*, and holds good in all ſimilar Caſes. If Metals now are thus diſſolv'd by their proper Acids, then dried, moiſten'd by the Air, dried again, and ſo on, by this repeated coagulation and inſpiſſation, they are wonderfully open'd, and reſolv'd, and at laſt become volatile. The *Calx* thus diſſolved by the moiſture of the Air, has the ſame Vertues it had before.

PROCESS CLXVI.

A Golden Tincture of Vitriol of Iron.

APPARATUS.

TAKE of the very red *Calx* of Vitriol, prepar'd according to *Proceſs* 164, *No.* 3. and exceeding dry 1 part, put it into a tall Bolthead, and pour upon it 20 parts of the beſt ſweet Spirit of Sea-Salt: Digeſt them together for the ſpace of a month, and you will have a golden Liquor of a ſweetiſh, ſtyptic, inky Taſte. Decant this Liquor, and put on freſh Spirit, and digeſt as before, and by a repetition of this Operation, there will remain at laſt an inert metallic Powder, whilſt the Liquors mix'd together make the Tincture we want.

USE.

BY this Experiment it appears, that Liquors ting'd with a remarkable Colour, may be procur'd from Metals without a Solution of their whole Body; for this Tincture truly contains part of the Subſtance of the Iron, inaſmuch as one drop of it is greatly efficacious in producing a black Colour, as you'll ſee at the end of theſe Lectures. The Spirit however is never capable of diſſolving the whole *Calx*, but only extracting part of it. A few drops of this Tincture taken faſting in *Spaniſh* Wine, invigorate, and deſtroy Worms. The chemical *Magi* placed their medicinal Gold in Iron: Is this therefore their medicated *Aurum Potabile?* See *Tachen. Hippocr. Ch.* p. 11. and *Baſil Valentine,* concerning this Tincture.

PROCESS CLXVII.

Iron diſſolved in Rheniſh Wine.

APPARATUS.

WITH 2 ounces of clean fine Filings of Iron, not at all ruſty, in a tall Bolthead mix 24 ounces of the ſtrongeſt Rheniſh Wine, and digeſt them in our wooden Furnace in 200 degrees of Heat for the ſpace of three or four days, frequently ſhaking them about: Afterwards let them ſtand quiet for four and twenty hours, and then pour off the Wine, which will be blackiſh, filter it, and put it into a Bottle, and ſtop it cloſe: This will have an inky, ſweetiſh, ſtyptic Taſte. Upon the *Reſiduum* pour freſh Wine, and proceed in the ſame manner, and then too you will have an Iron Wine, but no ways comparable to the preceding; for that particular part that is thus drawn from the Wine is ſoon exhauſted, the whole ſubſtance of the Iron not being here diſſolv'd, but ſomething only being extracted from it. This therefore is more properly a Tincture than a Solution.

USE.

HENCE then we ſee, that in Iron there is one part that is ſoluble in this gentle, oily, fermented, vegetable Acid, whilſt the other will not diſſolve in it. The firſt part of theſe now, is the nobleſt Medicine that I know of, either in Art or Nature, for reſtoring the human Body to its *hæmatopoietic* Vertue, when this is loſt from too great a laxity and weakneſs of the Solids, or a cold, inactive, watery diſpoſition of the Fluids: Certainly, if the medicinal Power of Metals appears in any Experiment, it does remarkably ſo here; for you will never in this caſe be able to do ſo much by the help of any Vegetable or Animal preparation, or any *Regimen* of Diet whatever, as you will by this Tincture of Iron. In ſtrong Health, however, and full Habits of Body, it does harm. I have often thought with myſelf, whether this was not the potable Sulphur of Metals, which alone was ſaid to be ſufficient for aſſiſting the infirmities of Nature? Certainly this is infinitely preferable to any *Aurum Potabile,* that has yet been divulg'd, nor is ever prejudicial, if it is but adminiſtred in proper caſes. But hence likewiſe we learn, that there is ſomething in Iron that is not ſo remote from the nature either of Vegetables or Animals: This certainly is evident, that it diſſolves with the greateſt eaſe. If a drachm of this Wine mix'd with three times as much Syrup of Sugar for a doſe, is given by a judicious Phyſician to young Perſons of either Sex, it proves an incomparable Medicine.

PROCESS CLXVIII.

A Solution of Iron in Vinegar.

APPARATUS.

TAKE of freſh Filings of Iron 1 ounce, put them into a tall Bolthead, pour upon them 20 ounces of the ſharpeſt diſtilled Vinegar, and let them boil in our Furnace for the ſpace of four and twenty hours. By this means, after the whole is grown cold, you will have an exceeding red Liquor, of a ſtyptic, ſweetiſh, diſagreeable Taſte, and thicker than the preceding Tincture made with Wine. This aſtringent Tincture of Iron, when it is filter'd and depurated, will tinge the Vial it is kept in, in ſuch a manner, that the ſtain will ſcarcely ever come out. If upon the remainder of the Filings you pour more Vinegar, and treat it in the ſame manner, you will again extract a Tincture, but in leſs quantity, and of a paler Colour, tho' ſtill evidently containing ſomewhat of Iron: And if this is repeated, there will at laſt remain a conſiderable quantity of the Iron that will not be diſſolved by the Vinegar.

USE.

IT'S ſurpriſing here what a conſiderable difference there is betwixt this Tincture of Iron prepared with Vinegar, and the former with Wine, whether you regard the Colour, Taſte, Smell, Thickneſs, or Effects. Hence it is evident, that this Metal may be eaſily diſſolved by Acids, but in a manner very different. This Solution of Iron by Vinegar, has a wonderful aſtringent quality, and hence is corroborating, and of ſervice in caſe of Worms, but muſt not however be every where made uſe of without proper conſideration. If it is taken with Sugar, it is more mild. How frequently now muſt Iron in Solution get into the human Body, as it ſo often in the common courſe of things meets with Acids, is diſſolved by them, and ſo is taken in with our Meat and Drink? Will it therefore inſinuate itſelf into the Blood, intimately mix with the Juices, and ſo furniſh Matter for a Stone in the urinary Paſſages, as was the Opinion of Dr. *Liſter?* This is certain, that it grows almoſt every where, and is every where conſtantly conſuming, and hence is produced from the Earth, and return'd to it again, ſo that if there is any Metal that is mutable and deſtructible, it muſt without all diſpute be acknowledged, that this is ſo remarkably.

PROCESS CLXIX.

Sublimation of Iron with Sal-Ammoniac.

APPARATUS.

TAKE of the freſheſt Filings of Iron, and the drieſt Flowers of *Sal-Ammoniac*, of each 4 Ounces, put them into a glaſs Mortar, and rub 'em together for a good while, the longer indeed the better. By this means, from theſe two Bodies, which were inodorous before, there preſently begins to riſe a volatile, very ſubtil, and as it were alcaline Vapour; for the acid part of the *Sal-Ammoniac* is attracted into the Iron, and hence its volatile alcaline part is ſet at liberty, and ſpontaneouſly flies off. Let there be ready a large, dry, glaſs Cucurbit, pretty wide at top, into which put the Powder thus prepar'd, taking care that it is ſpread broad at the bottom, and then fit on a Head, and apply a Receiver, luting the Joints with a common Lute made with Linſeed Flower. This being done, place the Cucurbit in a Sand Furnace, cover it with Sand quite to the rim of the Head, and give a Fire of 200 degrees. By this means then there will riſe a very acrid Vapour, which will diſtill into a very penetrating and exceeding volatile alcaline Liquor. When nothing more will come off with this degree of Fire, increaſe it 'till the top of the Head grows hot, and then there will begin to riſe Vapours, firſt of a white Colour, and then of various others, and at laſt the whole internal ſurface of the Head will be cover'd with a variety of white, red, yellow, green, and blackiſh Colours intermix'd with one another, and thus in a good meaſure repreſenting natural Flowers, from which they have taken their name. Keep up this degree of Heat for ſix or eight hours, and then let the whole ſpontaneouſly cool, and in the Receiver you will have an exceeding penetrating, volatile, alcaline, golden Liquor, with a ſmall quantity of a white and yellow Matter, and in the Head and its Beak, a very ſubtil, dry Subſtance of various beautiful Colours, which muſt be immediately remov'd, put into a hot dry Vial, and ſtopt up very cloſe, for otherwiſe it will ſoon grow moiſt with the Water in the Air, and run into a gold-colour'd, oilyiſh, rough, ſaline Liquor: In the dry form this Matter is call'd Flowers of Iron; in the latter fluid one, Oil of Iron *per Deliquium.* All the ſides of the Cucurbit too will be cover'd with the ſame ſort of Flowers, but they appear here more compacted, being melted as it were, and ſo conſolidated by the ſtronger action of the Fire: Theſe too muſt be carefully taken off, and kept dry. At the bottom of the Cucurbit there will be left a browniſh red Matter, of an exceeding rough Taſte. This in its nature is averſe to being kept dry, and hence, with a moiſt Air, melts, and runs into a thick, aſtringent, golden Liquor, which is another metallic Oil *per Deliquium.* When this is expoſed to the Air it rarefies, and puffs up in an extraordinary manner, and thus in ſome meaſure repreſents a kind of Fermentation. Betwixt the ſublim'd Flowers, now, and this *Reſiduum* there is a great deal of difference.

USE.

S*Al-Ammoniac*, which conſiſts of a Spirit of Sea-Salt and a volatile animal Alcali, by being rubb'd with the Iron unites part of its Acid with its metalline Body, by which means the alcalious part belonging to that acid one, is ſet at liberty, becomes volatile, and flies off: But at the ſame time another portion of the *Sal-Ammoniac* retaining its own proper nature, by being mix'd with the Iron thus corroded by the Acid, divides, carries up, and ſublimes a particular part of the Metal, which otherwiſe is ſo fix'd in the Fire; for it is not ſo eaſy as ſome Perſons tell us, to make the whole Body of the Iron riſe by the help of *Sal-Ammoniac*, but it ſeems here to be divided into one part, which becomes more volatile and aſcends, and another which is more fix'd, and remains at the bottom: This at leaſt appears to me to be the caſe, and hence I think I ſee the ſeparability of Iron into different parts. From this Operation then we learn the ſingular volatility of *Sal-Ammoniac*, which, now it is divided, is capable of carrying up a Metal that is naturally ſo fix'd and hard to fuſe. Hence the Philoſophers have call'd it the *Avis Rapax*, the *Aquila alba*, and the Key that unlocks the Bodies of Metals. Theſe Flowers have nearly the ſame Vertues as the *Ens Veneris* of Mr. *Boyle*; for they are a wonderful reſtorative, warming, aperient Medicine, containing the opened Body of the metallic Sulphur. They have an anodyne quality, likewiſe, often riſing to a ſemi-narcotic one. Theſe Flowers being digeſted with Alcohol when they are exceeding dry, give out a conſiderable quantity of a metallico-ſulphureous, golden Tincture. The *Fæces* too that remain at the bottom with Alcohol yield a Tincture of the ſame kind. Curious Perſons who are not ſparing of their labour take this *Reſiduum* of the Iron and *Sal-Ammoniac*, expoſe it to the Air, and thus diſſolve it, then inſpiſſate and coagulate it again, and ſo on, till at laſt they ſo ſurprizingly and profoundly (*eviſcerant*) embowel the metalline part, that they never repent either of their trouble or charge. Who that knows any thing of Chemiſtry is not acquainted with the Precept ſo often inculcated, diſſolve and coagulate? If this work now is ſufficiently repeated, may there at laſt be a true Mercury procur'd from the reſolved Metal? For my own part, I confeſs, I have tried this, but it has not ſucceeded. It is certain, however, that Experiments upon Metals with *Sal-Ammoniac* are of infinite uſe.

PROCESS CLXX.

A Preparation of Iron and Sulphur.

APPARATUS.

1. TAKE of Filings of Iron and Flowers of Sulphur, of each 1 ounce, mix them and rub them together for a conſiderable time in a glaſs Mortar, the longer the better, by which means they will grow hot and ſend forth a fetid Smell. Boil this fine Powder in Water for the ſpace of half an hour, and then pour off the decoction, filter it, and ſet it by. Upon the *Reſiduum* put more Water, and treat it in the ſame manner, and ſo proceed till it at laſt comes off without any Taſte. Mix all theſe Waters together, which have a kind of inky Taſte, and inſpiſſate them, and you will have ſomewhat of a very pure Vitriol of Iron.

2. Take ſuch another mixture of Iron, but 8 ounces in quantity, and work it with Water into a ſtiff Paſte. Preſs this hard down into an earthen Pot, and ſet it by, and in a ſhort time it will ſpontaneouſly grow warm, hot, very hot, emit Fumes, and often at laſt take fire. When this agitation is over, you will find the Matter altered, and converted into an equable Maſs. Rub this very well, and then boil it in Water, as in the preceding caſe, and you will hence too have an exceeding pure Vitriol of Iron, endued with beautiful medicinal Vertues.

3. Into Sulphur, in fuſion in the Fire, dip the end of an Iron Rod for ſome time, and it will be calcin'd and brittle. Or if upon the ſame melted Sulphur

you ſprinkle ſome Filings of Iron, you will have a *Calx* of Iron, which being treated as before, will yield nearly the ſame Matter.

4. And laſtly, if to Iron perfectly ignited you apply a roll of crude Sulphur, it will ſoon make the calcin'd Metal run down in drops, which being pounded, produce the ſame kind of *Calx*.

USE.

IN theſe four Experiments the very acid Oil of Vitriol which conſtitutes one part of Sulphur, being by rubbing in the two firſt caſes, and fuſion in the two laſt, applied to the Iron in a greatly increas'd ſurface, begins to act exactly in the ſame manner as was explain'd *Proceſs* 162, leaves the other oily part of the Sulphur, and unites with the Metal. And as this action always produces a great degree of Heat, it is no wonder at all that the oily part, which is eaſily inflammable, ſhou'd at laſt take Fire, that is to ſay, when theſe Subſtances are mix'd together in a conſiderable quantity, and then are thoroughly rubb'd and work'd together, and hard preſs'd down. *Mem. de l'Ac. Roy. des Sc.* Vol. II. p. 52. As ſoon as ever, therefore, in any of theſe four ways the Acid of the Sulphur has corroded the Metal, there is immediately produced the Matter of a Vitriol of Iron, and that an exceeding pure one too, as the Flowers of Sulphur are quite free from any metalline Taint. By this means then may be made true artificial chalybeate Waters. Theſe Powders the Chemiſts have call'd (Saffrons) *Croci*, on account of their Colour, and *Croci Aperientes*, becauſe there is in them an aperient, vitriolic Vertue; whereas other Powders prepar'd with an Acid and Fire are call'd aſtringent ones. Thus then, Gentlemen, in the *Proceſſes* from 162 to 171, I have laid before you the principal methods by which this Metal may be chang'd in ſuch a manner, as to produce ſomething new under various forms, and ſometimes ſuch Bodies as by means of the Fire, and other helps, may be made to give back again the very ſame Metal. As in various Metals, however, there occur particular *Phænomena*, hence they all require a peculiar management.

PROCESS CLXXI.

A Calx *of Lead with the Vapour of Vinegar.*

APPARATUS.

YOU ſee I have here a large Cucurbit, cut off in ſuch a manner as to have a very wide Mouth, which is fitted to this large Head. Within this I diſpoſe ſome thin plates of Lead, ſetting them pretty upright all round the circular Channel, ſo that they mayn't fall down. I then pour ſome Vinegar into the Cucurbit, place it in a Sand Furnace, fit on the Alembic with the leaden Plates, apply a Receiver, and with a gentle Fire diſtill for the ſpace of twelve hours, and then deſiſting leave the whole to cool for twelve hours more. Let the Plates be then gently dried, and they will grow white, and be cover'd with a white Powder which being gently bruſh'd off with a Hare's Foot, goes by the name of Ceruſs, or White-lead. And if you repeat this Operation a ſufficient number of times, the whole Body of the Lead will at laſt be converted into this white Powder, which is perfectly inſipid, and inodorous. The Vapour of the Vinegar which riſes during this Operation, condenſes into a Liquor, which is whitiſh, turbid, ſweet, nauſeous, and Styptic, and is call'd Vinegar of Lead, or a Solution of Lead.

USE.

HENCE then we learn, that Lead is very eaſily corroded by this gentle Acid, and from a malleable ſtate is ſoon converted into a looſe Powder, or brittle Scales. The Liquor too that riſes during the Operation is pregnant with the diſſolved Metal, and is a real ſolution of Lead, yielding a true Salt of it by inſpiſſation. When Lead therefore is expos'd to an Air, that is full of Acids, this operation is continually going on of itſelf, and hence leaden Bodies in theſe circumſtances are by degrees converted into a white *Calx*, and ſo gradually waſte away, and that ſo much the ſooner as the Air is more replete with an Acid. If Iron or Copper are treated in the ſame manner, they likewiſe will be reſolved on their ſurfaces, the firſt into a *Ferrugo* or red *Calx*, the other into an *Ærugo* or green one, whilſt the Liquor that diſtills from the Iron is of a Gold-colour, that from the Copper green. The Ceruſs, now, thus produced is compoſed of the acid Liquor of the Vinegar, and the diſſolved ſubſtance of the Lead; but the Acid lies conceal'd there, as we ſaw before in Iron. This Ceruſs by being ſprinkled upon them is of Service in gleeting, watery Ulcers, and diſorders of the Skin. If, when it is reduced to a fine Powder, it is received in with the Breath in inſpiration, and carried down into the Lungs, it cauſes terrible Aſthma's, that are almoſt incurable, and generally at laſt prove fatal. If it is taken in at the Mouth, and ſwallowed with the Spittle, it produces the worſt kinds of Diſorders in the *Viſcera*, Languors, Weakneſs, Pains, with intolerable Oppreſſions, and in the end Death itſelf. Sad inſtances of the very pernicious effects of this Metal one ſees daily amongſt thoſe Perſons who work Lead in any form, but particularly amongſt the Workers in White-lead. Let us beware therefore of this Poiſon, which having neither Smell nor Taſte, is ſcarcely taken notice of till it diſcovers itſelf by fatal Inconveniencies. From this Operation, now, we learn how eaſily Lead will loſe its metalline Nature, and be converted into a *Calx:* The ſame thing too appears in abundant different ways: Thus, if you melt Lead with a gentle Fire in an earthen Veſſel that is not glaz'd, it looks at firſt like pure Mercury, but preſently the Surface grows dull and has a pellicle form'd upon it, which being carefully taken off with an iron Ladle, is a kind of a *Calx*. The Surface then regains its Brightneſs, but there ſoon appears ſuch another Pellicle, and ſo on 'till at laſt the whole Body of the Lead will be converted into ſuch a Scum, which has likewiſe a poiſonous quality. If this *Calx*, or the former Cerus's, is calcin'd for a good while, and kept ſtirring upon the Fire, it is at length found to be increaſed in its weight, and acquires a bright ſcarlet Colour, and is then called *Minium*, or Red-lead: This likewiſe is obſerv'd in the leaden ore upon a long calcination. In ſeparating Silver from the Ore there is form'd a Scum, which conſiſts chiefly of Lead, and when it is of a yellowiſh red Colour is call'd Litharge of Gold, when paler, Litharge of Silver, which are nearly the ſame both in Matter and Vertue. The foſſil Plumbage too don't differ a great deal from all theſe, as it is a pretty natural leaden Ore. Lead therefore, though it exiſts under theſe various colours, weights, and forms, ſtill continues to be truly the ſame Lead, is diſſolv'd by the very ſame *Menſtruums*, and what it yields is the ſame; nor does it much ſignify whether you corrode Ceruſs, Litharge, *Minium*, or Plumbage, with Vinegar, for you hence have always the ſame Salt of Lead. Theſe have all too the ſame power of drying, and the ſame poiſonous quality is always found to continue in them. *Minium* acquires a conſiderable weight from the Fire. Is this from the Acid of the combuſtible Matter attracted into the Lead, or from an addition of the ſubſtance of the Fire itſelf? See *Boyle*, *Of the Ponderability of Flame*.

PROCESS CLXXII.

Vinegar of Lead.

APPARATUS.

1. BOIL Ceruſs for the ſpace of four hours, with 20 times as much ſtrong diſtill'd Vinegar, in a tall Bolthead plac'd in our wooden Furnace, often ſhaking the Glaſs. Let the whole cool, pour off the pure Liquor, filter it, upon the *Reſiduum* pour freſh Vinegar, and proceed as before, and repeat this till almoſt all the Ceruſs is diſſolv'd into a limpid form. All theſe Vinegars then being mix'd together, are found to have loſt their Acidity, and to be ſweet, nauſeous, and ſtyptic: Theſe are call'd Vinegars of Lead, and *Lac Virginale*, becauſe the Ladies make uſe of them to take away any red Spots, Puſtules, or little Ulcers in the Face. If theſe Vinegars, when they are filter'd till they are very pure, are diſtill'd in clean Veſſels till only one quarter remains, there comes off a nauſeous Water, which has a diſagreeable and very particular Smell, but is not acid, all the acidity of the Vinegar being retain'd in the diſſolv'd Ceruſs. Let the *Reſiduum* be kept under the Title mentioned, and be look'd upon as having the ſame Vertues with Vinegar of Litharge.

2. If inſtead of Ceruſs, you take Litharge of Gold or Silver, *Minium*, or Plumbage, and reduce them to Powder, and then boil them with Vinegar in the manner deſcrib'd, you will procure from all of them a Vinegar of Lead, that cannot be diſtinguiſh'd from one another. There is one thing indeed particular in it, and that is, that when it is cold, it is filtered with more difficulty, the Paper being clos'd up as it were, though it paſſes through eaſy enough when it is hot.

3. If upon this inſpiſſated Liquor of diſſolved Lead you pour freſh diſtill'd Vinegar, and boil them till they are reduced nearly to the conſiſtence of Honey, the Vinegar that is drawn off is found to have loſt a great deal of its acid quality, the Acidity being retain'd in the metalline Liquor that is left behind, which is oily, pinguious, of a ſweet Taſte, like Sugar, and is call'd Oil of Lead, conſiſting of the Metal and Vinegar. And the oftner this affuſion of freſh Vinegar and inſpiſſation is repeated, the more pinguious does the Liquor grow in proportion, and is afterwards dried with more difficulty.

USE.

HERE then we have a new method of calcining, diſſolving, and reducing to a liquid form a very heavy metal. And by this union of it with the Vinegar, we ſee there is produced a new Smell and Taſte, the acid part of the Vinegar being attracted and ſeparated by the Metal till it is impregnated and ſaturated. If Bodies are immers'd in this Vinegar of Lead till they are well penetrated with it, and are then dried, they are ſecured from Putrefaction, and remain incorruptible for a great length of time. The Humours of Animals it coagulates too, and ſo preſerves from corruption. If it is diluted, and then uſed as a Waſh, it in a great meaſure removes Puſtles, Redneſs, Eryſipelas's, and Phlegmons, and gives the Skin a beautiful whiteneſs, but at the ſame time often proves injurious to the health, at laſt bringing on a Conſumption, of which there have been melancholy inſtances. But when the condenſed Oil of Vinegar of Lead, abovementioned, is mix'd with an equal quantity of Oil of Roſes, it makes a white chemical Balſam, which is greatly commended by the Surgeons.

PROCESS CLXXIII.

A Salt of Lead with Vinegar.

APPARATUS.

1. TAKE ſome Vinegar of Lead, put it into a low Cucurbit with a very wide Mouth, and inſpiſſate it till you have reduc'd it nearly to the conſiſtence of an Oil, then ſet it by in a cold ſtill place, and there will be form'd at the bottom a white Maſs inclining to grey, conſiſting of fine *Spicula*, ſtanding upright. Pour off all the liquid part, and gently dry the remainder, and it will have a Sweetneſs like that of Sugar, and is call'd Sugar of Lead.

2. Let this common Sugar of the Shops be diſſolv'd in very ſtrong diſtill'd Vinegar, and let the ſolution by ſtanding quiet be depurated from its *Fæces*, and then be inſpiſſated to the thickneſs of an Oil, and ſet in a cold place, and it will ſhoot at the bottom into thick ſolid Cryſtals, exactly reſembling thoſe of vegetable Sugar, and having a ſaccharine Taſte.

3. If theſe Cryſtals again are diſſolved in freſh Vinegar, and depurated and inſpiſſated to the conſiſtence of an Oil, as before, you have a Liquor that is not eaſily dried with a ſmall Fire, ſo as to become hard, but is ſomewhat of a more fix'd nature, and with a gentle Heat melts like Wax. And the oftner it is thus impregnated with freſh Vinegar, and dried, the more fix'd does the Matter become in a ſmall Heat, nor fumes, but eaſily melts. And if this is then expos'd to a moderate Fire a conſiderable time, and whilſt it continues fluid is poured into another cold Veſſel, it ſurprizingly coagulates, even whilſt it is pouring through the Air, and becomes form'd into fine Threads, juſt like thoſe of a Spider's Web, which look exactly like Silver, and make a pretty appearance. This a *Jeſuit* formerly publiſhed as a Secret, under a parcel of hard Words, form'd by a tranſpoſition of their Letters. *Phil. Tranſ. Abr.* Vol. III. p. 325.

4. As ſoon as ever the Body thus coagulated into Threads is expoſed to a ſomewhat greater degree of Heat, it will melt again, and may be pour'd out as before. And if it is thus carefully and patiently melted and inſpiſſated a pretty many times, the *Fæces* being every time thrown away, and the Matter is then ſoften'd for a good while with a gentle Fire till it becomes one concreted Maſs, it will eaſily from its look paſs upon People that are not aware of it for true Silver. Here *Iſaacus Hollandus* deſerves to be conſulted concerning the Stone prepar'd from Lead. This *Proceſs* may at pleaſure be protracted by thoſe Perſons, who are pleas'd with ſuch appearances of Bodies as are not common.

USE.

THIS Preparation is call'd a Sugar, Salt, Mageſtery, and Vitriol of Lead, and teaches us how Lead may be ſo combin'd with a fermented vegetable Acid as to form a Body that is diſſoluble in Water. It is aſtringent, and ſtyptic, and coagulates the Blood pretty readily. If it is diſſolv'd in Water it makes a Vinegar of Litharge, which does ſervice externally in Inflammations. Internally it is commended in Spitting of Blood, Hæmorrhages, Piſſing of Blood, Gonorrhœa's, the Whites, and ſuch kind of Diſorders, as alſo to allay and ſoften any ſharpneſs in the Blood. But for my own part I confeſs I never dared to make Trial of it, as I have ſeen no very happy ſucceſs from its uſe by other Perſons, and as I know that there is ſcarcely a more deceitful or deadly Poiſon, than there is in this Lead, which will immediately return to Ceruſs, as ſoon as ever it meets with any thing that will abſorb its Acid. Hence you introduce a Poiſon into the Body, which can ſcarcely be afterwards extirpated. If Salt of Lead is gradually diſtill'd in a Retort, and at laſt urg'd with the ſtrongeſt degree of Fire, there comes off a pinguious inflammable Spirit, perfectly of another nature than the Vinegar was which was made uſe of, and at the bottom there remains a kind of Glaſs, which being expoſed to an intenſe Fire inſinuates itſelf through almoſt all kinds of Veſſels, and cauſing all other Bodies but Gold and Silver to vitrify, carries them along with it.

PROCESS CLXXIV.

A Salt of Lead with Spirit of Nitre.

APPARATUS.

1. UPON 1 ounce of Shot, Ceruſs, Litharge, or *Minium*, in a tall Bolthead, pour of Spirit of Nitre or *Aqua Fortis* diluted with 10 times as much Water 15 ounces, upon which there will be excited a violent Ebullition with a white Froth. When the Effervescence is over, place the Veſſel in our wooden Furnace, and let the Liquor boil for five or ſix hours, and then ſtand quiet and grow cold. Pour off the pure Liquor at top, filter it, and diſtill it in a Cucurbit to the appearance of a Pellicle, and there will come off a Water that is nauſeous, but not acid. Let the Remainder be ſet by in a cold place, and it will ſhoot into ſolid white Cryſtals, that are very heavy, will not diſſolve in the

Air, but are pretty durable, and are of a ſweet Taſte, but at the ſame time rougher than thoſe prepared by the preceding *Proceſs*. The Liquor too, after the Solution, Diſtillation, and Cryſtallization, has a ſaccharine ſweetneſs like that of the Salt.

2. If upon the Salt thus prepared, you pour freſh *Aqua Fortis*, diſſolve it, and inſpiſſate the Solution, you may thus too obtain an Oil of Lead, which is not dried without a pretty deal of difficulty, but gradually grows fix'd, ſo as to melt like Wax with a gentle Fire.

3. If this Salt is thrown dry upon a live Coal, it will not take Fire, but crackle moſt violently, and being impatient of the Fire flies about to the great danger of the By-ſtanders. If it is reduced to Powder, it may be melted with a ſtrong Fire.

USE.

HERE then we have a new method of generating a metalline Salt and its Oil; of producing a ſweet Taſte from a very acid and an inſipid one; and of procuring Glaſs from Metal: And here we ſee, that Spirit of Nitre does not produce an inflammable Salt with every Metal, as it does with Silver. This Salt has the ſame Vertues as the preceding, but is more corroſive and aſtringent.

PROCESS CLXXV.

Salt of Lead managed with Alcali's.

APPARATUS.

UPON 2 ounces of the Cryſtalline Salt of Lead of *Proceſs* 173, 174, very carefully dried, and finely powdered, pour 4 ounces of Oil of Tartar *per Deliquium*, and ſet them a digeſting, the longer the better. When they have ſtood a proper time, add 1 ounce of *Sal-Ammoniac*, mix 'em well together, and commit them to digeſtion again in a cloſe Veſſel. The ſaline Liquor that riſes whilſt they are thus digeſting, pour on again, and digeſt as before, and when you have repeated this three or four times, dry the Matter perfectly with a gentle Fire, expoſe it to a moiſt Air that it may be diſſolved, and then dry it again, and diſtill it in a glaſs coated Retort with ſucceſſive degrees of Heat, till you come to the greateſt that it is poſſible to excite with Sand, applying at the ſame time a large Receiver that has ſome clean Water in it. By this means then there will come off a threefold Matter, which you will be ſomewhat ſurpriz'd at, and there will remain a very ſingular Body at the bottom of the Retort, that is wonderfully altered.

USE.

THERE are a great many very curious things learn'd by this Experiment, which, if you'll give yourſelves the trouble to try it, you'll obſerve with pleaſure: For the Metal being ſo ſucceſſively open'd and reſolv'd by the oppoſite Salts, and then dried and diſſolved in the Air, is greatly chang'd, attenuated,

tenuated, and ſeparated from every thing that is not a metalline Mercury, ſo that it may by this means give us the true metallic mercurial part freed from all the reſt, if this, by a diligent application to the Art, can be at laſt attained to.

PROCESS CLXXVI.

A Calx *of Vitriol of Lead.*

APPARATUS.

TAKE the Vitriol of Lead of *Proceſs* 173, 174, dry it very well with a gentle Fire, and reduce it to a very fine Powder. Put this Powder into a glaz'd Plate, ſet it upon the Fire, and keep it ſtirring with a Tabacco-pipe till in a ſtrong Heat it will emit no more Fumes. By this means you will have a fine and almoſt inſipid Powder, which is another *Calx* of Lead made by the aſſiſtance of a Liquid.

USE.

ALL the Acid that was united with the Lead whilſt it was in the form of Vitriol, is here ſeparated from it by the force of the Fire, except that part which intimately adhered to it and did not appear externally, which is by this means ſtill much more cloſely combined with it.

PROCESS CLXXVII.

A Balſam of Lead with expreſs'd vegetable Oils.

APPARATUS.

1. IF you put granulated Lead, any of its *Calx's*, Ceruſs, Litharge, or *Minium*, into a glaz'd Pipkin, and add to it twice its weight of any expreſs'd Oil, and gradually expoſe it to an increaſing Heat, the Lead will begin to be melted before the Oil boils. And if you then continue to raiſe your Fire by degrees till you bring the Oil to boil, the Body of the Lead, or *Calx*, will diſappear, and will be ſo accurately mix'd with the Oil as to make a true Balſam, which by farther boiling may be reduced to a Body that will be very thick, and of ſome conſiſtence in the cold, and appear of a ſemi-metalline nature, but will melt again, and grow ductile with Heat.

2. If inſtead of Lead, or its *Calx*, you take that *Calx* that is prepared by *Proceſs* 176, or even Salt of Lead, ſo that it is but well dried, by mixing an expreſs'd Oil with it, and treating it in the manner deſcrib'd, you will have juſt ſuch another Balſam of Lead, conſiſting of true Metal and Oil.

USE.

HENCE then we ſee, that a true Metal, and that a very heavy one too, may, by the aſſiſtance of Fire, be diſſolved by a vegetable Sulphur, and be ſo mix'd with it, and diſperſed through it, as to lie quite concealed. How often therefore may we be at a loſs about the admixture of Metals with other Bodies? How wonderfully may they lie hid from our Obſervation? How frequently therefore may they be extracted from Bodies in which one wou'd not have ſuſpected they were contained, and then be falſly ſuppoſed to be produced by tranſmutation? Let us hence be caution'd to be aware of the wiles of the Sophiſts. Plaiſters made with theſe Balſams ſtrengthen and cheriſh the Parts, prove diſcutient, and by their abſorbent quality draw out and obtund ſharp Humours. But they are particularly of ſervice when we want to make Veſſels capable of holding Water: For if *Minium* is boil'd in Oil to a proper thickneſs, and is then well rubb'd upon a Stone Wall, made nearly red hot, ſo that it may penetrate into it intimately, it will prevent any Water's ſoaking through it, as well as if it had been built with Cement. We uſe it likewiſe to faſten Faucets into their Caſks, by which means they are prevented from leaking.

PROCESS CLXXVIII.

A Balſam of Lead with a diſtill'd vegetable Oil.

APPARATUS.

TAKE the Sugar of Lead of *Proceſs* 173, dry it very gently, and then upon the Powder thus produced pour four times as much ætherial Oil of Turpentine, and boil 'em for ſome time in a tall Bolthead, which may be eaſily done by ſetting it in Linſeed Oil, and heating that juſt enough to make the Oil of Turpentine boil, which will happen a good deal ſooner than the Linſeed Oil will boil, itſelf. By this gentle ebullition, then, almoſt all the Sugar of Lead will be diſſolved in the Oil of Turpentine, and thus you will have a Balſam of Lead with a diſtill'd Oil.

USE.

THIS Balſam is fit for the ſame uſes as that of the preceding *Proceſs.*

PROCESS CLXXIX.

Glaſs of Lead.

APPARATUS.

1. TAKE of *Minium* 2 parts, of very clean Sand ground to a farinaceous Powder 1 part, rub 'em very well together till they are thoroughly mix'd, put the Mixture into a clean Crucible, melt it, and when it has been in fuſion for ſome time, if upon dipping a Tobacco-pipe into it, the melted matter adheres to it, and appears pellucid, pour it out upon a Marble, and you will have an inſipid, inodorous, yellow, pellucid, brittle Body, which will grow hard in the Cold, but will melt again with Heat. This therefore has acquired the name

of Glaſs of Lead. This, when it is in fuſion in the Fire, runs through all the Veſſels we know of in the World, as Water does through a Sponge. And the ſame, when it is melted, converts almoſt all the Bodies we are acquainted with into Glaſs, and then carries them along with it through the Pores of the containing Veſſels, leaving Gold and Silver, however, unaffected. That the *Minium* and Sand may ſooner run into Glaſs, ſome Perſons add Nitre, others Sea-Salt, and then urge them till the Salt is melted.

2. If Sugar of Lead is expos'd in a Crucible to a Fire gradually increas'd, the Vinegar being diſſipated, it will flow and be converted into a yellow Glaſs, and at the ſame time there will appear in the Metal ſome ſurprizing beautiful Colours, like thoſe of the Rainbow, or a Peacock's Tail.

3. If Lead is melted, and kept a good while in fuſion in the Fire, it will produce a Spume, and by degrees be almoſt all converted into it, and if this is then melted with a ſtronger Fire, the Lead will by this means be converted into Glaſs, without the addition of any thing elſe, though not without much labour, and that prudently directed; whence at laſt the Art is eaſy.

4. Take of *Minium* 4 parts, of Sand 1 part, and of Sea-Salt decrepitated, and very dry, 2 parts. Mix them well together, the more intimately the better. Put the Mixture into a Crucible, cover it very cloſe, fuſe it thoroughly, and then let it ſtand quiet. By this means then the Salt will be melted into a Maſs at top, and at the bottom, upon breaking the Crucible, you will find a Glaſs that muſt be carefully ſeparated from the other Parts, and preſerved for metallurgic uſes, for there it is of vaſt ſervice.

5. If theſe Glaſſes are mix'd with a little Charcoal, and then melted, a true Lead is eaſily recover'd from them again.

USE.

THUS then, by the help of Fire, diſſipating a very poiſonous metallic Vapour, we ſee this Metal chang'd from its perfectly malleable nature, into a very brittle Maſs that is truly glaſſy, nay which, by an admixture of a *Calx* of Sand, or Flints, becomes perfect Glaſs. In what ſurprizing forms, therefore, may Metals lie concealed? And how eaſily may they often be brought back again to their natural ſtate? When a certain ſulphureous part is ſeparated from them, do Metals vitrify in the Fire? A proper reflection on the preparation of Glaſs of Antimony, and other Experiments, wou'd perſuade one to think ſo. And, upon this Sulphur's being reſtor'd again, do they regain their metalline form? This ſeems confirm'd by many Obſervations, eſpecially in the management of Lead. *Mem. de l'Ac. Roy. des Sc.* 1709. p. 218. *&c.* This Glaſs of Lead is that ſevere probationer of Metals, which in the Fire deſtroys every thing but Gold and Silver, and leaves them exceeding pure without any diminution of their weight. Upon this principle depends the whole docimaſtic Art, which is of ſuch vaſt ſervice in human Life. And let this ſuffice for beginners. Upon this head, if your curioſity leads any farther, conſult Meſſ. *Boyle*, *Bohn*, *Homberg*, and *Geoffry*. But before I paſs on to the next Metal, let me once more caution you, to beware of the Fumes, Powder, and indeed every part of Lead, for it always proves one of the worſt of Poiſons.

PROCESS CLXXX.

The ſolution of pure Silver in Spirit of Nitre, or Aqua Fortis.

APPARATUS.

1. I TAKE 1 ounce of Silver purified by being coppell'd according to Art with ten times its weight of Lead, which I melt in a very clean Crucible, and when it is in fuſion pour it into ſome cold Water contained in a cylindrical Veſſel, holding it about 8 inches above the Water. The Silver, then, you hear, enters with a hiſſing noiſe, and falls to the bottom in little Grains, and is now call'd granulated Silver. This I put into a clean Urinal. I then take 2 ounces of *Aqua Fortis*, into which I throw a grain of pure Silver, and if I find that it is in a ſhort time intirely diſſolv'd, ſo that the Liquor is quite limpid, I know that the *Aqua Fortis* is good; but if it will not diſſolve, or only renders the *Aqua Fortis* turbid, it is a ſign that the *Aqua Fortis* is not pure. The firſt ſort is call'd by the Aſſayers proved *Aqua Fortis.* 2 Ounces of this then I pour upon the ounce of granulated Silver in the Urinal, upon which the *Aqua Fortis* preſently begins to be put in motion, boil, ſmoke, and hiſs about the ſurface of the Silver, and then to grow hot, be agitated more violently, emit red Fumes, and diſſolve the Silver in ſuch a manner that it intirely diſappears. By this means then you have a pellucid, colourleſs Liquor, of a very acrid, bitter, and moſt violent cauſtic taſte. At the bottom of the Veſſel, however, there is always ſomewhat of a very black Powder; and this is pure Gold, which is either conſtantly mix'd with the Silver, or elſe perhaps, according to Monſ. *Homberg*'s opinion, is eaſily produced by the Lead and Fire, and being not diſſoluble in the *Aqua Fortis*, is precipitated fron the diſſolved Silver. Pour out the limpid Liquor into a very clean Glaſs, and you have a ſolution of Silver.

2. If inſtead of *Aqua Fortis* you make uſe of Spirit of Nitre the Solution will be more violent, and ſooner effected, but the *Phænomena* will be all the ſame: For *Aqua Fortis*, and Spirit of Nitre, either prepared with Bole, or Oil of Vitriol, ſeem ſcarcely to differ from one another, except in a greater or leſs degree of the very ſame kind of Acidity. But here let me obſerve, that if the ſmalleſt quantity of Fountain-Salt, *Sal-Gem*, Sea-Salt, *Sal-Ammoniac*, or any of their acid Spirits, happens to be mix'd with the Spirit of Nitre, or *Aqua Fortis*, either during the Diſtillation of them, or afterwards, then they will not be capable of diſſolving Silver.

USE.

IF this Solution is pellucid, and without Colour, it is a proof that the Silver was pure; but if it has a greeniſh caſt, it is a ſign it had ſomewhat of Copper in it, and then the Solution is not fit for the following *Proceſſes*. Here then we ſee, that the Silver, by being united with the Acid part of the Nitre keeps ſuſpended in the watery part of it. If a drop of this Liquor is applied to any ſoft, warm part of the human Body, it burns and conſumes it in an inſtant; and hence it at once eats down the hard callous Lips of Ulcers, ſeparates ſemi-putrid parts, and immediately extirpates Marks, Scars, Warts, and ſmall Cancers. It may be diluted with pure Water, without growing turbid, or cauſing a Precipitation; but if there is the leaſt admixture of Salt in the Water, it loſes its clearneſs. This diluted Solution is one of the greateſt Detergents, but wherever it touches the Skin, it makes a black ſpot that cannot be removed till the *Epidermis* itſelf is ſeparated. How wonderfully therefore may pure heavy Silver lie conceal'd from the Eye in light limpid Water? Its Taſte, however, which is exceeding bitter, will diſcover it.

PROCESS CLXXXI.

Vitriol of Silver.

APPARATUS.

1. IF into the Solution of the preceding *Proceſs*, you throw a grain of pure Silver at a time, till the laſt grain will not be diſſolved, then if this ſaturated Solution is ſet by in a cold place, there will ſoon begin to appear very thin, white, ſmooth, little *Lamellæ*, applied to, and lying upon one another, and being made up of triangular *Spicula*, as it were, exceedingly like thoſe of Nitre. When theſe are formed, pour off the remaining Liquor, and you will have Cryſtals, Salts, or Vitriols of Silver, which can ſcarcely be dried, and which on account of their exceeding Acrimony, are quite intractable.

2. And if the former Solution, not ſaturated with any more Silver, is a little inſpiſſated, ſo as to loſe, for inſtance, about $\frac{1}{10}$th part of it, and is then ſet quiet in the cold, the Silver will become concreted at the bottom of the Veſſel into a white ſolid Cryſtal, in other reſpects the ſame as the preceding, but more acrid, inaſmuch as it is impregnated with a greater quantity of Acid. This therefore is a much more violent Cauſtic.

USE.

HENCE then we learn the mutual attraction there is betwixt Silver and this particular Acid, whereas it reſiſts almoſt all others, growing black, indeed, when it is expoſed to them, but not diſſolving. This Vitriol of Silver is the moſt ready Cauſtic, producing a black ſpot on the Skin if it does but lightly touch it, which will not be remov'd till the Cuticle peels off.

PROCESS CLXXXII.

The Lunar Cauſtic, or Lapis Infernalis.

APPARATUS.

1. TAKE a piece of Potter's Clay that is well work'd, ſtiff, and not very moiſt, form it into a cubical figure, and ſet it on a Table, and with a conical Iron pierce it perpendicularly in ſeveral places from the upper ſurface almoſt quite through, taking care that the Holes are ſmooth within, that the

Matter which is pour'd in may not be rough. When you have thus made as many Holes as you have occaſion for, preſs the tops of them with your Finger in ſuch a manner as to form a ſpherical Cavity round each of them, that you may the more eaſily pour in the melted Matter.

2. This being done, take the bottom of a glaſs Urinal, cut out, lay upon it the firſt Cryſtals of the preceding *Proceſs*, and ſet it upon a live Coal, by which means the Cryſtals will ſend forth a noxious Fume. When they are melted, and do not fume any longer, pour them out cautiouſly into the conical Cavities made in the clay Cube, which the melted Matter will enter with a hiſſing Noiſe. If any of it happens to harden in the Glaſs, ſet it on the Fire again, and ſo proceed till you have poured all your Silver into theſe moulds.

3. As ſoon as ever the Matter has acquired a ſolid Conſiſtence, break the Clay, take out the ſilver Cones, lay them on a dry hot Paper, and on that dry them thoroughly. As ſoon as you obſerve this is the caſe, wipe the ſurface of them with a dry, hot, Hare's Foot, and then put them immediately into a dry Vial, which ſtop as cloſe as poſſible. Thus then you have the *Lapis Infernalis*, which is of excellent ſervice in Surgery, and may be kept good for many years.

USE.

THE Acid of the Nitre, whilſt it is over the Fire, has its Water ſeparated from it in form of Vapour; and that part of the Acid too is carried off, which is more than what the Silver in the Cryſtals is capable of retaining. The Silver, however, holds faſt a certain portion of the Acid in ſuch a manner that it will not fume, but remains fix'd with the Metal, even when it is in Fuſion. This Acid being retain'd with the Body of the pure Silver, conſtitutes a ſolid Body, and is, perhaps, the pureſt and ſtrongeſt Acid that can be any ways prepared. When the Acid thus adhering to the Silver in a ſolid form, is expoſed to the Air, from its impatience of dryneſs, it attracts the Moiſture out of the Air, and ſo diſſolves. This *Lapis Infernalis*, too, may be intirely diſſolved in Water, and then, by the aſſiſtance of Copper, all the Silver may be recovered from it, which is then found to be inſipid, inodorous, inactive, neither acid nor corroſive, but exceeding ſimple, pure, and perfectly native, without any alteration at all. The Acid therefore adheres only to the ſurfaces of the Elements of the Silver, without at all affecting their proper nature, and hence the Silver may be procured from it again in its original form. This Stone is an exceeding powerful Cautery, burning the warm moiſt parts of the human Body to an Eſchar in an inſtant. Under this Eſchar, Nature will of courſe produce an Inflammation, and ſo throwing off the Eſchar will render the crude part pure. By this means, therefore, diſagreeable, fungous, and cancerous Excreſcences on the ſurface of the Body are ſucceſsfully removed. Hence the Surgeons greatly extoll its uſefulneſs. The Phyſician too may hence learn the ſurprizing power of this Acid, when it is thus collected and fix'd by the Silver. If it is given in this form internally, it is the moſt immediate eſcharotic Poiſon; and for this reaſon muſt never be made uſe of upon any account whatever. I knew a Chemiſt to whom this production of his own Art prov'd fatal.

PROCESS CLXXXIII.

The Silver Hydragogue of Mr. Boyle *or* Angelus Sala.

APPARATUS.

1. TAKE of the beſt Nitre 1 ounce, which diſſolve in the pureſt diſtill'd Water, that the Solution may be as perfect, and the Liquor as limpid as poſſible. Then take of the choiceſt Cryſtals of Silver, prepared according to *Proceſs* 181. *No.* 1. 1 ounce, which diſſolve in 3 times as much of the ſame Water, ſo as to have a perfectly pellucid Liquor, without the leaſt appearance of any thing turbid. This being done, mix theſe two Liquors together, and the Mixture will be clear, homogeneous, and ſimple, nor will the Silver precipitate, but be moſt accurately combined with the Nitre. Put this pure Liquor into a clean Urinal, and with a Fire that is not at all ſmoky, and in a place that is not duſty, evaporate to a Pellicle, and the Water that exhales will be pretty pure. Set the remainder by in a cold ſtill place, carefully covering the Glaſs that no Duſt may fall in, and it will ſhoot into Cryſtals like thoſe of Nitre. Gently pour off the fluid part, and treat this as before, and the Silver and Nitre will be united together in the ſimple form of Cryſtals. Dry theſe very gently.

2. Have in readineſs the lower part of a Urinal, cut off as high as the middle of the Belly, upon this lay the Cryſtals thus form'd from the Silver and Nitre, having firſt dried them upon a Paper. Set the Glaſs with the Cryſtals ſo near the Fire, that it ſhall make them fume, and dry them, but ſhan't be ſtrong enough to melt them. This then being carefully guarded againſt, keep the Matter conſtantly ſtirring with a glaſs Rod, that by this means the whole being ſucceſſively expoſed to a pretty ſtrong Fire, it may be dried thoroughly, and ſo be intirely freed from the ſharp Acid which adhered to it, and rendered it cauſtic, and which may be ſeparated by this gentle Calcination, whereas if the Fire is ſtrong enough to melt the Maſs, it will more intimately fix it with its corroſive Acrimony. This Calcination muſt be continu'd a good while, and the Matter muſt be kept conſtantly ſtirring till it will emit no more Fumes, tho' the Fire is almoſt ſtrong enough to melt it; for towards the end, if it ſhould accidentally be put in Fuſion, it is not of ſo much conſequence, as the Fire then will have ſeparated all the external Acid. Thus then you have a purging Silver of an exceeding bitter Taſte, which muſt be kept cloſe ſtopp'd in a dry Vial.

USE.

THIS is a ſecret and ſurprizing Art of combining Silver with Nitre. By this means, deſigning Men can conceal Silver in a conſiderable quantity of Nitre, 10 times as much, for inſtance, which being then ſpread upon an equal quantity of Lead in Fuſion, will remain in the Cupel after all the reſt is gone off, and thus will impoſe upon the unwary Spectator, who will hence imagine, that the Lead by this Art has one 10th part of it converted into Silver. If you have a mind, however, to diſcover the cheat, diſſolve the Maſs of Nitre and Silver in ten times as much pure diſtill'd Water, and put a poliſh'd Plate of Copper into the Solution, and all the Silver, not a Particle excepted, will be immediately precipitated upon the Copper, and the bottom of the Veſſel, and then be perfectly pure, being freed both from the Spirit of Nitre and the Salt. If any of theſe Cheats, therefore, pretend to a Salt that will produce Silver, examine it in this manner, and you will know the truth of it. If the Matter, now, thus compoſed of the Salts of Silver and Nitre, is reduced to a very ſubtil, dry, Powder, it will have an exceeding bitter Taſte, but will by no means be ſo cauſtic as the Cryſtals of Silver were before. If a little of it is applied to an Ulcer, it has the ſame effect as the *Lapis infernalis*, but in a much leſs degree. If 2 grains are rubb'd very fine in a glaſs Mortar, with 6 grains of Loaf-Sugar, and this Powder is made into nine Pills, with 10 grains more of Crumb of new Bread, and taken faſting by a grown Perſon, drinking preſently after them 4 or 6 ounces of warm Water and Honey, they will purge very gently by Stool, carrying off a thin Water, which is often ready to paſs without ones perceiving it. It is good in the Worms, killing both the *Tæniæ* and *Aſcarides*, It cures many inveterate Ulcers too; and it does ſervice in dropſical caſes, purging without any conſiderable griping. Beware, however, of too large Doſes, or the too frequent uſe of it; for it always corrodes and particularly weakens the Stomach. In ſuch caſe *Rob* of Juniper Berries do great ſervice.

PROCESS CLXXXIV.

Burning Silver.

APPARATUS.

TAKE a live Coal of *Dutch* Turf that is thoroughly on Fire and does not emit any Smoke, make a little hole in its upper ſurface, in which lay a drachm of *Lapis infernalis* that is very dry, and it will immediately melt, take fire, burſt into Flame, crackle, look exceeding bright, and in every reſpect reſemble burning Nitre. When the Flame is gone out, there will remain juſt as much pure Silver in the cavity as was made uſe of in preparing the Stone, out of which therefore it may be taken without any loſs.

USE.

THIS beautiful Experiment teaches us, that Acids adhere only to the ſurfaces of the Elements of Silver; ſhews us the manner in which Acids act when they are united with Metals, being then diſpoſed only round the heavy, metalline Particles, and thus arming them with ſharp *Spicula*; demonſtrates, that Silver remains abſolutely immutable whilſt it is corroded by an Acid, and that it may lie concealed and act under a great many various forms; and points out to us the difference there is betwixt that potable Silver, which ſubſiſts in a ſaline form by means of an Acid adhering to it, and that other of the Adepts, where the very ultimate Elements of Silver are ſuppos'd to be converted into a Liquor that will mix with our Humours, nor can afterwards be reduced to Silver again.

But here we ſee particularly that the acid Spirit of Nitre, whilſt it is combined with the Silver in a ſolid form, is as inflammable when it is mix'd with combuſtible Matter, as the Body of the Nitre was itſelf: This ſeems owing only to the Silver which is immutable by the Spirit of Nitre. And laſtly, this is the only method in which pure Silver can, by ſimple combuſtion, be ſeparated from heterogeneous Bodies united with it. It appears, therefore, that the Acid does not act upon the mercurial part of the Silver, nor upon its fixing Sulphur. Many more things might be ſaid upon this head, but as they are not abſolutely neceſſary to our preſent purpoſe, I omit them.

PROCESS CLXXXV.

The recovery of Silver from its ſolvent Spirit of Nitre.

APPARATUS.

TAKE 1 ounce of the pureſt Silver well diſſolved in Spirit of Nitre, dilute it with 20 times as much diſtill'd Rain-water, and then into this very limpid Solution, heated in a cylindrical Glaſs, put ſome poliſh'd Plates of Copper. As ſoon as ever this is done, the poliſhed ſurface of the Plates will begin to grow dull, will acquire a greyiſh Colour, and in a ſhort time ſprout out as it were, and be covered all over with a kind of thick Down; and at the ſame time too the Liquor, which before was like Water without any Colour, will grow greeniſh, and proportionably deeper and deeper, as more of this Down fixes upon the Copper. If you then ſtrike the Plates, there fall off flocculent Sheaths to the bottom of the Veſſel, upon which others will be again preſently formed from the Liquor, exactly like the former. The Liquor too will become ſtill greener, and the Plates will be diminiſhed. Theſe being ſhook off, you have again more, and ſo on. When you perceive at laſt that nothing farther will fix upon the Copper, leave the Veſſel for ſix hours, ſtrike off the greyiſh Down from the Plates, gently pour off the Liquor from the ſubſiding Matter, and filter it, and it will be of an exceeding beautiful green Colour, ſharp, and perfectly copperiſh. The Plates at the ſame time will be a great deal diminiſhed, both in bulk and weight. Let the Matter that remains at the bottom of the Glaſs be waſh'd, by frequent additions of clean hot Water, till it is render'd very pure. Then dry it thoroughly over a clear Fire, and you will have a very fine, ſhining, ſilver Powder, which will give you back again almoſt all your Silver, pure, mild, and inſipid, containing nothing at all either of the Acid, or the Copper.

USE.

HERE then you have a method of calcining Silver into ſuch a very fine Powder, as you can't eaſily equal in any other way. If this is rubb'd with Mercury, it very readily produces an *Amalgama*, which otherwiſe is ſo difficult, nor can be obtained without a conſiderable loſs of Mercury. If you melt this Powder in a Crucible, you have the Silver again you made uſe of in the Solution. Hence then it appears how ſurperficially the Acid of the Nitre adheres to the

Silver, as all of it without any remainder is eaſily attracted from the Silver to the Copper. If you view the Liquor with a Microſcope during the Operation, you evidently ſee little Maſſes of Silver carried rapidly, with the Acid of the Nitre, to the immerged Plates, from every point of the Solution. But when theſe *Spicula* come to the poliſhed ſurface of the Copper, then the Acid is attracted into the Copper, and the particles of Silver, now deprived of their Acid, remain upon the ſurface, and being there continually increaſed by the application of new ones, form a ſoft kind of Sheath, which incloſes the Copper; and, which is pretty ſurprizing, this attraction is carried on ſo efficaciouſly, that at laſt there don't remain the leaſt portion of Silver in the Solution. The Copper therefore attracts the Acid of the Nitre more powerfully than the Silver does. Hence this Operation is effected by the attraction and cribration of the Acid from the Body of the Liquid, the Acid paſſing on through the Pores of the Copper, whilſt the Particles of Silver not being able to enter, are collected upon its ſurface: Examine theſe *Phænomena* with a Microſcope, and you'll be very agreeably entertain'd. Here then the Acid of the Nitre remains unalter'd in the Silver, is collected perfectly the ſame in the Copper, and may be procured from that again.

PROCESS CLXXXVI.

The Luna Cornea.

APPARATUS.

1. INTO the pureſt Solution of Silver made with Spirit of Nitre, according to *Proceſs* 181. No. 1. and then diluted with 4 times its quantity of pure Water, and put into a large glaſs Veſſel, drop a ſmall quantity of a very pure ſtrong Brine of Sea-Salt, made almoſt ſcalding hot. The very moment then that it falls in, it grows white, and in the twinkling of an eye the Liquor becomes ſo thick that a Perſon that was not aware of it, wou'd be quite ſurpriz'd at it: But there does not appear any Efferveſcence. Proceed to drop more of the Brine in, till the Liquor will not grow turbid with it any longer; and then let it ſtand quiet, and there will be a large quantity of a thick, white Matter collected at the bottom, and you will have a limpid Liquor at top. Pour this off very gently, and drop into it a little more hot Brine, and if it then is not diſturb'd, it is a ſign you have obtained your end, but otherwiſe there will ſtill remain ſome Silver to be ſeparated from it. Upon the precipitated white Matter pour very clean hot Water, and waſh it till you find it to be quite inſipid. Then put it into a Urinal, boil it a little with the pureſt Water, and ſhaking them well together, pour them into a paper filtering Bag, upon which the Water will paſs through, and there will remain a white Matter in the Paper, which muſt be dried with a gentle Fire. This then is a *Calx* of Silver precipitated from Spirit of Nitre, or *Aqua Fortis*, by Sea-Salt; and the weight of this is found to be nearly one fifth more than that of the Silver made uſe of, ſo much being added to it by theſe Salts.

2. Let this *Calx* of Silver be put into a clean Crucible, plac'd in a wheel Fire, and ſtand till it is melted, which is eaſily effected. As ſoon as ever it is in fuſi-

on, pour it out upon a Marble, and it becomes a heavy, ſhining, opake, brown Maſs, which, though it is brittle, yet has ſome degree of tenacity, and hence has acquired the epithet *cornea*, or horny. In this, now, is truly contained all the Silver that was diſſolved in the Spirit of Nitre, together with the Acid of the Nitre, and the Sea-Salt, which are become ſurprizingly concreted with it, nor are eaſily ſeparable from it again: For if with the intenſeſt Fire you endeavour to force out the Spirits, which was ſo eaſily done in the *Lapis Infernalis*, the greateſt part becomes volatile, and flies off, whilſt the *Reſiduum* will ſcarcely be recovered to Silver, but remains altered by the combination of theſe Salts, ſo intimately united and fixed in it, nor diſcovering themſelves by any ſaline quality. If 1 part of the pureſt Silver, calcined according to *Proceſs* 185, is mix'd with 2 parts of *Mercurius ſublimatus*, and the Compound is diſtill'd in a Retort, at laſt, with the ſtrongeſt Sand Heat, there will a *Luna Cornea* remain at the bottom of the Retort, which will be perfectly the ſame as the former. If inſtead of Sea-Salt too you mix Spirit of Sea-Salt with the ſolution of Silver, you will have the ſame likewiſe. And Mr. *Boyle* ſays, that Silver precipitated from Spirit of Nitre by Oil of Vitriol, and then waſhed and melted, will be converted too into a true *Luna Cornea. Orig. Form.* p. 203, to 209.

USE.

THIS Experiment, which is of infinite uſe, teaches us, that the ſmalleſt difference of ſome phyſical circumſtance, may occaſion the greateſt difference in the Body phyſically produced: For if Silver is expoſed to *Aqua Regia*, it will not unite with its Acid, and yet when the ſame is diſſolved in Spirit of Nitre, if you add Sea-Salt to the Solution, and thus only make an *Aqua Regia*, the Acid of this will be intimately combined with the Silver, and that with ſome very ſurprizing *Phænomena*. Thus, for inſtance, if to 2 parts of this precipitated *Calx* of Silver you add 1 part of *Regulus* of Antimony, and after you have ground them well together, diſtill the Mixture in a Retort with a ſand Heat, you will by this means procure a Butter of Antimony of the ſame weight with the *Regulus* you made uſe of, the Silver at the ſame time remaining at the bottom with part of the *Regulus*, which being recover'd again, always yields a true Gold. Hence then we are certain, that the additional weight of the *Calx* of the Silver was owing to the *Aqua Regia* that was combin'd with it, becauſe here we ſee it goes into the mercurial part of the Antimony. No wonder therefore that ſome of the top Maſters in Chemiſtry, as *Becher*, *Boyle*, *Homberg*, and *Stahl*, have in this Experiment ſo much conſidered the Power, and latent arſenical Nature, as it were, of Metals and Salts. Who could have imagin'd, that in the exceeding inſipid Body of the *Luna Cornea* $\frac{1}{5}$th part ſhould be the vaſtly corroſive acid of *Aqua Regia?* But what a ſingular power has Sea-Salt upon Metals? How wonderfully may it lie concealed among them, and yet at laſt be recover'd from them again in its full ſtrength? Nay here we ſee that Gold itſelf may be procur'd from a Matter, in which no Gold could be diſcovered before by any docimaſtic Art whatever. So that here again the Adepts whiſper into their Children's Ears, *in Sale & Sole*, Nature has plac'd the utmoſt perfection. If this *Calx* of Silver now is privately mix'd with Nitre, and then thrown into melted Lead, it will yield you both Gold and Silver, which will then be falſly imagin'd to proceed from the Lead: Let us therefore beware of ſuch impoſitions. But the Nature of our preſent deſign forbids us to enter into theſe things too minutely; and therefore I leave them to your own meditation. Give me leave to add, however, that Monſieur *Homberg* aſſerts, that by the aſſiſtance of Tartar, Quick-lime, *Sal-Ammoniac*, and Whites of Eggs, he extracted from ½ a pound of Silver, 3 drachms, and 50 grains of true Mercury. But thus much of the nature of Silver for our preſent demonſtrations. This *Luna Cornea* is not diſſolved either by *Aqua Regia*, *Aqua Fortis*, or Fire.

PROCESS CLXXXVII.

A Solution of Tin in Aqua Regia.

APPARATUS.

1. IF to *Aqua Fortis*, or Spirit of Nitre, you add a 6th part of Sea-Salt, *Sal Gem*, Fountain-Salt, or *Sal Ammoniac*, or Spirit of Sea-Salt, it by this means becomes an *Aqua Regia*, and diſſolves Gold, but not Silver. And again, if by Diſtillation you draw *Aqua Fortis* off of Sea-Salt, or Spirit of Sea-Salt off of Nitre, you will have the ſame *Aqua Regia*. And laſtly, if you take 2 parts of Nitre, 3 parts of Vitriol, and 5 parts of Sea-Salt, and mixing them together, diſtill as in the Diſtillation of *Aqua Fortis*, you will by this method procure the beſt *Aqua Regia* likewiſe. This therefore is owing to a Mixture of Nitre and common Sea-Salt.

2. Into ſome *Aqua Regia* contained in a clean Urinal, throw a ſmall quantity of Tin, and there will appear a violent Solution: Proceed in this manner till it has diſſolved as much as it is able, and you will have a thick, and kind of oily Solution. If this is then diluted with 20 times as much, or more Water, there will be precipitated the diſſolv'd Matter of the Tin, which being perfectly waſh'd with warm Water, and then dried, produces a white Powder, called a Mageſtery of Tin.

3. If Tin is thrown into *Aqua Fortis*, there ariſes a prodigious Effervеſcence, and the Tin diſſolves, puffs up, and appears in the form of a thick Soap, or the White of an Egg.

USE.

THIS is a particular manner of Solution. The diſſolved Matter is in ſome meaſure bitteriſh, and in that reſpect reſembles a Solution of Silver. The *Calx* prepared according to *No*. 2. is preſcribed by many Phyſicians as a ſingular Remedy in hypochondriacal and hyſterical Diſorders. But I confeſs I am not fond of this metalline preparation, as there are others that are ſafer, which will anſwer the ſame purpoſe. If it is mixed with a proper quantity of *Pomatum*, it makes a famous Coſmetic for Perſons whoſe Faces are disfigured with little ulcerous Puſtles. It is very difficult, with the intenſeſt Fire, to reduce it again to Tin. By this Experiment it appears, that of all Metals, Tin diſſolves with the leaſt quantity of Acid. It's ſurprizing now, that this Metal, when it is diſſolved in *Aqua Regia*, does not fume: If it is mix'd however with double its quantity of *Mercurius Sublimatus Corroſivus*, and diſtill'd in a Retort, the firſt Liquor that comes off always emits fumes, and exhales till none of it remains.

PROCESS CLXXXVIII.

The Solution of Copper in diſtill'd Vinegar.

APPARATUS.

1. IF Plates of pure Copper are diſpoſed in an Alembic, as we directed ſome time ago concerning thoſe of Lead, *Proceſs* 171, then the Vinegar, as it diſtills, becomes a green Liquor, and if you continue the Operation long enough, the whole ſubſtance of the Copper will by this means be diſſolved. The Liquor thus procured being filter'd and inſpiſſated with a moderate Heat, acquires a green Colour like that of an Emerald, becomes of a diſagreeable nauſeous Smell, and the very ſmalleſt drop of it proves inſtantly emetic. The Plates being dried, yield an *Ærugo* or Flower of Copper, but not the true Verdegreaſe of Copper, which is made only at *Montpelier* in a very particular manner, by the help of the Vapour of red Wine, digeſted with Grapes that have been preſs'd: Hence this *Menſtruum* is ſcarcely acid, as the former is, but oily, pinguious, and unctuous.

2. If the common *Ærugo* of the Shops is boil'd in a tall Bolthead with pure diſtill'd Vinegar till you have a Tincture, and you then pour that off and add freſh Vinegar, and boil, and ſo proceed till the laſt Vinegar by boiling will be tinged no longer, there will then remain a good deal of indiſſoluble Matter at the bottom, and thus demonſtrate that it is not corroded Copper alone that produces this *Ærugo*. If all theſe ting'd Liquors are depurated by Filtration, and are then diſtill'd till there remains only $\frac{1}{4}$th part they make a ſtrong Liquor of Copper. See *Proceſs* 53. From this by inſpiſſation you have green Cryſtals, which being too much dried have their Acid expell'd, and hence grow blackiſh.

USE.

THIS *Proceſs* then demonſtrates the eaſy ſolubility of Copper, ſhews us the origin of Flowers of Copper, or the common *Ærugo*, explains to us why poliſh'd Copper grows black ſo readily, and by Copper's thus growing ſo very eaſily green with Acids, will help us to diſcover this Metal, (which has a ſurprizing emetic and purgative quality,) when it lies conceal'd in Silver. If watery, looſe, ſanious, virulent Ulcers are touch'd with this Liquor, it helps to quicken, contract, dry, and cleanſe them.

PROCESS CLXXXIX.

The Solution of Copper in Sal Ammoniac.

APPARATUS.

WITH 1 part of Filings of the pureſt Copper, mix 3 parts of *Sal Ammoniac*, and 4 parts of clean Water, and with a moderate Fire, in a Cucurbit cut for the purpoſe, dry the Paſte, and then ſuffer it to diſſolve again in the Air. Repeat this Reſolution and Exſiccation ſome number of times, and you will at laſt obtain almoſt an intire Solution of the Copper. Boil this Mixture in Water, filter it, and inſpiſſate it a little, and you will have a blue Tincture, and if according to art you bring this to cryſtallize, you will have ſome agreeable ſaline Cryſtals of Copper.

USE.

HERE then you ſee how Copper and Salts act upon and unite with one another. This Liquor is the famous Anti-epileptic for Children. If a few drops of it are given to them faſting in Mead, it moves by Stool, excites a *Nauſea*, and has a wonderful effect upon their tender Stomachs, quickens them, brings away any Water or Mucous lodg'd in the Stomach and Inteſtines, and deſtroys Worms. By this means therefore it cures ſome bad habits of Body, and ſome kinds of Epilepſies.

PROCESS CXC.

The Solution of Copper in Aqua Fortis.

APPARATUS.

INTO common *Aqua Fortis*, or Spirit of Nitre in a clean Urinal, throw a ſmall quantity of very fine Filings of pure Copper. Upon this there will be excited a prodigious Effervеſcence with red Fumes, and in an inſtant the whole Liquor will acquire a pleaſant green Colour. Proceed in this manner till the laſt Portion thrown in will not grow green any longer. When the Liquor is depurated by ſtanding quiet, and being filtered, inſpiſſate it to one half.

USE.

HENCE we ſee the effect of this Acid of Nitre upon Copper. This proves an Emetic in the very ſmalleſt quantity. It kills all Inſects, and hence if it is diluted with a good deal of Water, it expeditiouſly deſtroys Fleas, and Lice, both the common and Crab-lice. It has the ſame effect upon Ulcers as the Vinegar of Copper; but muſt be uſed with prudence.

PROCESS CXCI.

The Solution of Copper in Aqua Regia.

APPARATUS.

INTO *Aqua Regia*, or Spirit of Nitre, throw Filings of Copper, and proceed as in the former *Proceſs*, and the effect will be juſt the ſame.

USE.

AQua Fortis, therefore, and *Aqua Regia*, equally diſſolve Copper. There is no ground therefore for the Opinion of thoſe Chemiſts, who from any diverſity in them, have pretended to account for one's diſſolving Gold only, and the other Silver. This certainly ariſes purely from the ſingular reciprocal diſpoſition of Bodies to one another, nor can be come to the knowledge of but by Experiments alone. And for the ſame reaſon they argue as unreaſonably concerning the reſemblance of the nature of Metals, from their being diſſolved by the ſame *Menſtruum*. Sound Chemiſtry proceeds very cautiouſly in things of this nature, and is afraid of Univerſals, unleſs when collected from Obſervations alone.

PROCESS CXCII.

The Solution of Copper in a volatile Alcali.

APPARATUS.

1. UPON 1 drachm of Filings of Copper in a clean glaſs Veſſel, pour 12 times as much of a good alcaline Spirit of *Sal Ammoniac*. Stop the Veſſel, ſhake it about frequently, and you will have a Tincture at firſt of an azure, and afterwards of a violet Colour, which will be extremely beautiful. Pour off the Tincture, upon the *Reſiduum* put freſh Spirit, and by this means almoſt all the Copper will be gradually diſſolv'd and converted into a Tincture.

2. If Filings of Copper are moiſten'd with 3 times their quantity of Oil of Tartar *per Deliquiuum*, and then digeſted, dry'd, and diſſolv'd, and this is repeated ſome number of times, and then the Matter is boil'd, filter'd, and inſpiſſated, you will by this means obtain ſuch another Liquor, but a fix'd one.

USE.

THIS volatile alcaline Tincture beautifully contains the ſubſtance of the diſſolved Copper. If a Perſon takes it faſting in a little Mead, and walks gently after it, beginning at firſt with 3 drops, and afterwards doubling the doſe every morning, and then repeating the laſt doſe, *viz.* 24 drops for ſome days, it opens, attenuates, warms, and proves the moſt powerful and ſpeedy Diuretic. By the help of this alone, I formerly cured a perfect *Aſcites*, ſuch a prodigious diſcharge of Urine being excited, that it run as out of an open'd Cock, upon which the Integuments of the *Abdomen* became ſo looſe that they might be wrapt over one another. I then only ordered a dry reſtorative Regimen,

gimen, and the Patient grew perfectly well, and enjoy'd a good ſtate of health many years after. This, as it happen'd in my younger days, gave me great encouragement, but upon trying the ſame Medicine afterwards in like caſes, the ineffectual uſe of it gave a check to my vanity, and taught me that Nature has a great hand in theſe happy events. Now I am convinced, that among the various kinds of Dropſies, ſome may be cur'd by different methods, and ſome not at all. In acid, watery, weak, cold, mucous, pituitous Diſorders, the ſame Tincture, however, is often uſed with ſucceſs. But it's time for us now to paſs on to the examination of Mercury, and therefore I ſhall only add here, that the Solution of Copper in all acid, alcaline, and compound Salts, either latent or open, appears by every kind of trial to be very eaſy; for even the expreſs'd Oil of Olives, and the diſtill'd Oil of Turpentine, and others, which always contain a latent Acid, will by being digeſted with Copper, acquire a green Colour, and at the ſame time be rendered fit for ſome chirurgical uſes.

PROCESS CXCIII.

The Purification of Mercury.

APPARATUS.

1. TAKE ſome Mercury bought of the Company at *Amſterdam*, put it into a Bag made of a round piece of Leather, which tie as cloſe as poſſible with a piece of ſtrong Packthread. Lay this Bag with the Mercury upon a large glaz'd Diſh, and then preſs it with a good deal of force, and the Mercury will run out pure through all the parts of the Bag. When it is almoſt all out, twiſt the Bag round, and if you manage it artfully, you will be able to preſs it all through. Upon treating the Mercury of *Amſterdam* in this manner, I have not found any foulneſs in the Leather.

2. I took 2 pounds of the ſame Mercury, and putting it into a clean glaſs Retort, with a ſand Heat, diſtill'd it into a glaſs Veſſel that was open at both ends, and at bottom had an orifice that lay under Water; and the whole Body of the Mercury roſe without any *Fæces*. This Diſtillation I repeated three times with the ſame Retort; and I recover'd my 2 pounds of Mercury. In the Retort, indeed, there remained a very ſmall quantity of a fine red Powder, but it did not weigh any thing worth taking notice of; even then, however, there appeared nothing feculent. So that this Mercury, even by this method of treatment, gave no ſign of being at all foul, which is an excellent proof of the goodneſs of the Commodity.

3. Take of the ſame Mercury 1 pound, put it into a Retort, and add of pure Lime ſlack'd in the Air 2 pounds, and then diſtill with a ſand Heat in a Retort, and you will have your pound of Mercury again; nor even by this means will you have any *Fæces*, which had there been any, would in this way certainly have diſcovered themſelves.

USE.

THESE are the common methods of purifying Mercury, in order to fit it for the following Operations. From this *Proceſs* then, we learn the volatility of Mercury, and the degree of it; and hence appears the great purity of that which is ſold by the Company at *Amſterdam.* Concerning the Alchemiſtical Purification of it, perhaps I may treat in another place.

PROCESS CXCIV.

The Solution of Mercury in Aqua Fortis.

APPARATUS.

TAKE of pure Mercury 4 ounces, of *Aqua Fortis* 6 ounces, put them into a clean Urinal, which ſurround with a ſmall Fire, that the whole may grow hot. The globular Body of the Mercury then at the bottom will begin to diſcover an Effervefcence, and will conſume with exceeding red Fumes, and a production of Heat. When this is all diſſolved, add a little freſh Mercury, and ſo proceed, till there at laſt, in this Heat, remains ſome part undiſſolved. Let the Liquor grow cold, and pour it into another Veſſel, and you will then find the Mercury diſſolved into a pellucid Liquor, even to a Microſcope appearing homogeneous, which has an abominable rough Taſte, the Smell of Spirit of Nitre or *Aqua Fortis*, and the Colour of Water.

USE.

HERE then we ſee Mercury, which is one of the opakeſt of Bodies, grow pellucid with *Aqua Fortis*, or Spirit of Nitre. This Body, therefore, which is 14 times heavier than theſe fluids, continues ſuſpended in the middle of them, without producing any effect at all from its greatly ſuperior ſpecific gravity. And even here it remains perfect Mercury, abſolutely unchang'd, being only ſurrounded by the Acid, as will appear hereafter. And again, it is ſo equably diſtributed through every part of the Solution, that if you take only one drop of it, and examine it according to Art, you will find the Mercury in it bear the ſame proportion to the whole Mercury diſſolved, as the drop does to the whole Solution. Here then is Matter of meditation, both for the Lovers of Chemiſtry, and Hydroſtatics. How minutely muſt the Mercury be here divided? How equably muſt the Acid be united with every Particle of it? And how equably muſt the acid part, now it is united with the Mercury, be diſtributed with that, through its own watery Phlegm? This Solution is very cauſtic, and almoſt intractable, burning all the parts of the Body it is applied to with very great Pain, and exceſſive Heat. Hence it proves efficacious in extirpating Warts. If a very ſmall Particle of it touches the Skin, it ſoon turns it of a red purple Colour. *Aqua Regia* now does not eaſily diſſolve Mercury, nor Spirit of Salt; and yet corroſive ſublimate of Mercury is a true Salt of Mercury diſſolved by Spirit of Sea-Salt, or *Aqua Regia*, for it produces all the proper effects of *Aqua Regia*, and being poured upon Salt of Tartar, gives back again the Sea-Salt. If it is firſt precipitated, it may be diſſolved by *Aqua Regia*. With Sea-Salt alone it may be ſublimed into a mercurial Salt.

PROCESS CXCV.

Vitriol of Mercury.

APPARATUS.

1. IF ſuch a Portion of Mercury is diſſolv'd in hot Spirit of Nitre, or *Aqua Fortis*, that it will at laſt take up no more but leaves a ſmall Portion undiſſolved, then, if this Solution is pour'd into a cold Veſſel, there will ſpontaneouſly concrete a ſaline, pellucid, whitiſh Matter at the bottom. And if you then pour off the Liquor at top, there will remain an exceeding acrid, moiſt, ſaline Body, that will diſſolve in Water, but that is intractable.

2. If the remaining Liquor is inſpiſſated to one half, and then ſet in a cold place, it will ſhoot again into Cryſtals like the former.

3. But if you take 1 part of Mercury, and 2 parts of the pureſt decrepitated Sea-Salt reduced to Powder, and put them into a Cucurbit, and expoſe them for five or ſix hours to a very ſtrong Fire; then, if after they are grown cold, you break the Cucurbit, you will have a ſolid dry ſublimate of Mercury in a true vitriolic form. The common ſublimate of Mercury too is a true Vitriol of Mercury, but a ſemi-volatile one.

USE.

MERCURY, therefore, by Spirit of Nitre, is reduced to an imperfect Vitriol, by Spirit of Salt, to a perfect one: But at the ſame time, the Vitriol from the Spirit of Nitre is fixed, that from the Spirit of Sea-Salt, volatile; which is a conſiderable difference. The Acrimony too from the Spirit of Salt is greateſt.

PROCESS CXCVI.

White Precipitate of Mercury.

APPARATUS.

INTO a ſolution of Mercury ſo ſtrong, that the *Aqua Fortis* or Spirit of Nitre will take up no more, and which conſequently contains no more Acid than what is juſt requiſite to diſſolve the Mercury, pour twice as much clean Water. At the ſame time take care to have by you a ſtrong Brine of the pureſt Sea-Salt made hot, which drop into this diluted ſolution of Mercury. By this means then the Liquor in thoſe places where the Brine falls in, will immediately become white, opake, and turbid. Shake the Veſſel about, and the whole will grow white and thick, and a white Powder will be precipitated to the bottom. Proceed thus as long as the Solution is affected by the Brine in the ſame manner, and by this means it will be ſeparated into a white Precipitate, which will fall to the bottom, and a clear Liquor ſwimming at top. When the Brine will render the Liquor no longer turbid, let the Veſſel ſtand quiet a little, and all the white Powder will ſubſide. Gently pour off the limpid Liquor, and keep it by itſelf. Shake about that part of the Liquor that remains at the bottom with the Powder, pour them together into a paper filtering Bag placed in a Funnel ſtanding in a Bottle, and there will drop through a pellucid Liquor, which you may add to the former. In the filtering Bag then will remain a white Powder, upon which pour ſome Water, made very hot, and it will paſs through the Paper, ſaline, and acid. Proceed in this manner till the laſt Water comes off as inſipid as it was put on, and then there will be a white, and almoſt inſipid Powder left in the Bag. Dry the Paper and Powder with a gentle Fire, and keep the Powder under the Title of *Mercurius præcipitatus albus.*

USE.

THE acid Spirit of Nitre, attracted into the Mercury, and now diluted with Water, as ſoon as ever the Sea-Salt is mix'd with it, becomes an *Aqua Regia.* But *Aqua Regia* does not diſſolve Mercury as Spirit of Nitre does, and hence the Body of the Mercury is expell'd from its former Solvent, and falling to the bottom makes a precipitate; and then the hot Water waſhes away the *Aqua Regia* that externally adheres to this Powder. There is ſome of the Acid, however, ſtill remains united here with the ſubſtance of the Mercury, and hence it has a particular Vertue, as appears by many Experiments. This Powder, if it is rightly made, of all the preparations of Mercury that we are acquainted with, for internal uſe, is perhaps the very beſt; for it acts efficaciouſly, and ſafely enough. If it is rubb'd with three times its weight of Loaf-ſugar, it furniſhes us with a Medicine, which, may be, better deſerves the name of a *Panacea Mercurialis,* than any other prepar'd from Mercury in the moſt laborious manner. For treat Mercury in what way ſoever you will, its medicinal Vertue will principally depend upon the quantity of Acid that adheres to it: If this Acid, therefore, is in greater abundance, and adheres to the Mercury more externally, it then acts rougher, and not ſo ſafe; if there is leſs of it, and it is more intimately combined, its effect is milder, and leſs dangerous; but this is the caſe in this precipitate. If the Powder with the Sugar abovementioned is given faſting to an adult to the quantity of 9 grains, it purges by Stool, gently provokes Vomiting, deſtroys Worms, opens, frees, and purges the chylopoietic ſyſtem, and attenuates a pituitous Matter, and thus cures Gonorrhœa's, the Itch, venereal and other Ulcers, and many other Diſorders. If this doſe is repeated once a day for ſome time, it brings on a gentle Salivation. If you accurately mix a drachm of this precipitate with an ounce and a half of *Unguentum Pomatum,* or *Roſatum,* it makes a ſafe and efficacious Ointment for extirpating Inſects in the Skin, and cures the Itch, Ulcers in the Face, and other very ſtubborn ones. You won't wonder therefore that I wou'd ſubſtitute it in the place of the boaſted *Panacea's.* If you lay this precipitate upon a glaſs Plate, expoſe it to a ſoft Fire, and keeping it conſtantly ſtirring with a glaſs Pipe, calcine it gently for a conſiderable time, it becomes ſo mild that it will neither vomit nor purge any longer, nor will ſcarcely raiſe a Salivation. Hence if it is given internally, it acts exceeding mildly; and then the Chemiſts extoll it for a Diaphoretic, and Corrector: But indeed it is then ſo mild, that it often does but little good. If this Powder is rubb'd upon hot poliſh'd Braſs, it makes it look exactly like Silver; but the Colour is preſently deſtroyed again by the Fire, or will wear away of itſelf.

PROCESS CXCVII.

Red Precipitate of Mercury.

APPARATUS.

1. TAKE half a pound of the liquid ſolution of Mercury of *Proceſs* 194, put it into a Retort that will hold twice the quantity, and then applying a Receiver, diſtill almoſt to a dryneſs in our wooden Furnace, taking care that your Fire is ſo gentle, that it ſhall never boil. At the bottom then you will have a ſolid, white, heavy Maſs, which is vaſtly corroſive, igneous, and quite intractable. About the ſides of the Retort, too, you will here and there have ſomewhat red, yellow, and white, ariſing from the Mercury, beginning there to be dried, and making an agreeable appearance. The Liquor that is drawn off is a pretty pure weak Spirit of Nitre, and may be kept for cleaning Glaſſes, or other uſes. This then is a ſort of reduction of diſſolved Mercury into a Vitriol.

2. Place the Retort in a Sand Furnace, lute on a Receiver, and diſtill with a gentle Fire that there may be ſo much time betwixt the drops, that one may moderately tell four or five, and proceed in this manner, till you begin to perceive ſome red Fumes: Then immediately apply another large Receiver. The Liquor that thus comes off is a good Spirit of Nitre, ſtronger than the former, which you muſt ſave for its proper uſes. Urge the *Reſiduum* with a gradually increaſed Fire, and there will continue to riſe red Fumes, which at laſt will be exceeding red, and fiery, and fill the Receiver. Then raiſe your Fire to the greateſt degree, and keep it up for the ſpace of two or three hours, and you will have a vaſtly ſtrong yellow Spirit of Nitre, which, if it is immediately ſtopt up in a glaſs Veſſel, will after years emit gold-colour'd Fumes; ſo that this is one method of preparing the ſtrongeſt Spirit of Nitre, or a kind of rectification of it. It muſt be confeſs'd, however, that its nature is by this means ſomewhat altered; for it won't ſo readily excite a Flame with diſtill'd Oils as other Spirit of Nitre does. When all is grown cold, at the bottom of the Retort you will have a ſolid Maſs of a bright ſcarlet colour, and betwixt this and the Neck, and in the Neck, there will be a great variety of very beautiful Colours, ariſing from a white, yellowiſh, yellow, greeniſh, red, and very red Matter that is lodged there. Break the Retort cautiouſly, and take the red Maſs out of the Belly, carefully ſeparating that part that lies at top, and is not of ſuch a fine ſcarlet Colour; for that is very corroſive. The very red Maſs keep under the Title of *Mercurius præcipitatus ruber.*

3. The Chemiſts being ſurprized at the beautiful bright Colour of this mercurial Powder, and the remarkable fixity of it now, though it was volatile before, took it into their heads, that by proceeding on in the ſame manner, they could convert this fix'd Matter into Gold. Upon this Precipitate, therefore, they pour'd freſh Spirit of Nitre, and drew it off again, and, by repeating this a great number of times, they thought Gold would be generated, which *Sylvius*, in his *Poſthumous Works*, aſſerts, did actually ſucceed. To Perſons, however, who think coolly of theſe things, this does not at all appear to be credible.

Paracelſus himſelf, in the preparation of his precipitate, orders Spirit of Nitre to be drawn a good many times from the Mercury.

USE.

HENCE then we learn the mutable nature of Mercury, which here we ſee chang'd from a fluid form to a ſolid one, from a volatile Diſpoſition to a fix'd one, from a ſoft to a corroſive one, and from its own proper Colour, to almoſt all others. Manage it however in what manner ſoever you will, by the aſſiſtance of an alcaline Salt, Quick-lime, or Filings of Iron, and Diſtillation in a Retort, it always returns in its original form, and weight, without any alteration at all. This which is call'd *Vigo*'s Precipitate, is acrid, corroſive, excites pain if it is applied to parts that lie bare, produces an Eſchar, and generates a thick white *Pus*, and ſo cleanſes the Lips and Bottoms of ſemi-putrid Ulcers, and diſpoſes them to an eaſy cure. Internally it is not given without danger, as by its cauſtic quality it is ready to inflame the *Viſcera*, producing very great pains, and both vomiting and purging with extreme Gripings, as well as provoking a diſcharge both by Sweat and Urine. If it is given in too great a doſe, which ſhould never exceed 3 grains, or if it is repeated too often, it raiſes a Salivation with all its Symptoms, and then cures many Diſeaſes that are not eaſily cured by any other method. It is rougher and more dangerous than the white Precipitate. *Paracelſus* and *Van Helmont* teach us to correct it, by drawing Alcohol off of it ſome number of times by Diſtillation, and by this means, as a good deal of the Acid is ſeparated from it, it does grow milder, and muſt then be given in a larger doſe. And they made uſe of the Water of the Whites of Eggs for the ſame purpoſe, and with the ſame ſucceſs. Others by boiling it in ſtrong diſtill'd Vinegar, diſſolve it, and by filtering it, depurating it, and diſtilling the Vinegar from it a pretty many times, procure a milder Powder. But what do we get by this? The white Precipitate is ſuch a medicine as this already, without all this trouble. In a word then, it is the corroſive Acid that is combin'd with the Mercury, that makes it operate powerfully in a ſmall doſe. The more, therefore, there is of it, and the more externally it adheres to the Mercury, the more violently it acts; as the leſs there is, and the more intimately it is united, it is milder, and muſt be taken in a larger quantity to produce the ſame effect. If this Precipitate is put into a thin glaſs Plate, and ſet upon the Fire, and kept continually ſtirring with a Tabacco-pipe, it becomes of a deeper Colour; and if you continue this Calcination for a good while, it at laſt becomes ſo mild that it will ſcarcely operate at all.

PROCESS CXCVIII.

Sublimate of Mercury.

APPARATUS.

DISSOLVE half a pound of Mercury in a ſufficient quantity of *Aqua Fortis*, according to *Proceſs* 194, and then cautiouſly inſpiſſate it to a white dry Maſs, according to *Proceſs* 197. *No.* 1. Take of decrepitated Sea-Salt 10 ounces, and the ſame quantity of common Vitriol calcin'd till it is white; rub theſe by themſelves very ſtrongly, and for a good while in a marble or glaſs Mortar, with a glaſs Peſtil, and in a dry hot place, and then mixing them nicely together, add the Mercury, which muſt be mixed intimately with them likewiſe. Put the Powder into a glaſs Bolthead, the Belly of which is ſo large that the Mixture will but one third fill it, and the Neck of which is cut off ſo low, that it is not above 7 inches long. Place the Bolthead in a ſand Furnace, taking care that the bottom of the Cucurbit touches the iron Pot, and that the Sand riſes juſt as high about it as the ſurface of the included Powder, and no higher. Then give a very gentle Fire, which increaſe by the ſloweſt degrees, till a Vapour begins to exhale out of the Mouth of the Cucurbit, of which beware, for it is prejudicial to the Lungs. When all the Moiſture is perfectly evaporated, cover the Mouth with a Paper, and then increaſe your Fire to ſuch a degree as to make the Pot red hot, and the Matter will riſe upon the ſides of the Cucurbit into ſemi-pellucid white Cryſtals, which go by the name of *Mercurius ſublimatus corroſivus.* When the Cucurbit is grown cold, break it, and take out the ſublimate, ſeparating it carefully from the *Fæces*, and the ſoft Powder that lies upon it, and keep it in a dry Vial. Concerning the *Venetian*'s method, ſee *Tachenius* in *Hippocr. Chem.*

USE.

THE white mercurial Maſs conſiſts of Mercury and *Aqua Fortis* combin'd together: The white *Calx* of Vitriol being mix'd with the Sea-Salt, endeavours to expell its Spirit, *viz.* a Spirit of Sea-Salt: Whilſt therefore theſe, by the aſſiſtance of the Fire act upon the mercurial Powder, from the Spirit of Nitre which is in the Mercury, and the Spirit of Sea-Salt which is diſlodged by the ſuperior Acid of the Vitriol, there is produced an *Aqua Regia.* The Phlegm of this is carried off by the firſt gentle Heat, and then its ſtrong Acid unites with the Mercury, and corrodes it. But as *Aqua Regia* is of the Nature of Sea-Salt, and the Spirit of that does not, like the Spirit of Nitre, fix Mercury, but rather renders it ſemi-volatile, hence the Mercury is here ſublim'd. This ſublimate, now, is a true, ſolid, dry, Vitriol of Mercury, which is conſiderably durable even in the Air itſelf. Its *Baſis* is a very pure Mercury, and the other part is the ſtrongeſt Spirit of Salt that can be obtain'd by any Art, and which here exiſts in a ſolid form. And with regard to this acid Spirit of Sea-Salt, it is a *Lapis Infernalis* of Mercury, and is the moſt powerful corroſive we know of, conſuming all the parts of the animal Body it does but touch, and producing an Eſchar which quickly ſeparates. Hence it eats down the moſt ſtubborn Lips of Ulcers, and extirpates Warts and indurated Glands. This that famous Surgeon *Joannes a Vigo* knew very well, as appears from his *Trochiſii de Minio*, which is an incomparable Remedy for conſuming and eradicating ſcrophulous Humours by ſuppuration. The Taſte of this Vitriol is horribly rough. A grain of this diluted in an ounce of Water, is a Coſmetic, if it is uſed with prudence. By ſimply waſhing with it, it proves a Poiſon to all Inſects in the Skin. If a drachm of ſuch a Mixture, ſoftened with Syrup of Violets, is taken two or three times a day, it performs wonders in many Diſeaſes eſteemed incurable. But it muſt be cautiouſly adminiſtred by a prudent Phyſician. Beware, if you don't underſtand the proper method. This corroſive ſublimate of Mercury, when it is mixed with Metals, has a very beautiful, nay inimitable effect upon them, and indeed,

deed, which the Chemiſt may a little wonder at, it ſurpriſingly changes even Silver itſelf. *Boyl. Orig. Ferm.* p. 196, to 203. Certainly, this Preparation of Mercury is a Key that lets us into an infinite number of profound chemical ſecrets. By means of this, poſſibly, Silver has ſome part of it converted into Gold, no ways diſcoverable in the Silver before. *See Proceſs* 186. *Uſe.* Hence is prepared the *Menſtruum Peracutum* of Mr. *Boyle*, as well as many others. And I may venture to ſay, no Chemiſt will ever repent of the labour he employs upon this corroſive ſublimate of Mercury. Here you ſee that *Aqua Regia* diſſolves Mercury, firſt diſſolv'd in *Aqua Fortis*, more beautifully than any *Aqua Fortis* can; and that the Spirit of Sea-Salt ſublimes it, tho' it was before fix'd by the Spirit of Nitre. Sublime this *Mercurius Sublimatus*, according to Mr. *Boyle*'s advice, with an equal quantity of *Sal Ammoniac*, and you will have a ſurprizing Salt.

PROCESS CXCIX.

Turbith of Mercury.

APPARATUS.

1. TAKE of the pureſt Mercury 4 ounces, put it into a clean Urinal, and pour upon it of the choiceſt Oil of Vitriol 8 ounces. Heat the Veſſel very gradually, and when it is grown hot, ſet it upon live Coals, that the included Matter may boil very gently, and it will emit Fumes which are poiſonous, for which reaſon let the Urinal be placed under a Chimney, that the Vapour may not be diſperſed, and come at your Lungs. The Mercury then that has collected itſelf at the bottom of the Oil of Vitriol will begin to be diſſolv'd, and if you keep up the ſame Fire, the Solution will at laſt be compleat. By this means you will have a very white Maſs, which, by continuing the Fire, calcine till it will fume no longer. The Powder then will be exceeding white, perfectly like Snow, and horribly corroſive and intractable, and is called, a *white* Calx *of Mercury, prepared with Oil of Vitriol.* This may be made in the manner deſcribed, but ſcarcely in the common ones.

2. Reduce the dry hot Maſs to a very fine Powder in a glaſs Mortar, and at the ſame time have by you a glaſs Veſſel with ſome very pure hot Water, at leſt 20 times as much as your Mercury. Throw the powder'd *Calx* into the Water, and the inſtant it is in, as it falls to the bottom, it loſes its white Colour, and acquires a very beautiful lemon Colour. Shake the Veſſel well about for a good while, that the Powder may be thoroughly mix'd with the Water, and then let it ſettle, and pour off the Liquor into another Veſſel. Waſh the Matter that remains at the bottom till it is become abſolutely inſipid, and then dry it thoroughly with a gentle Fire, and you will have an agreeable lemon-colour'd Powder, which is the Turbith Mineral we want.

3. Let the firſt Liquor pour'd off ſtand quiet for ſome time, and then filter and inſpiſſate it to $\frac{1}{6}$th, and you will have a mercurial Water; for if you drop into it a little Oil of Tartar *per Deliquium*, there will be precipitated a reddiſh Powder. This Liquor therefore may be kept under this Title.

USE.

THUS the exceeding ſtrong Acid of Vitriol, being united with the Mercury, produces a very fix'd white Powder that will bear a great degree of Heat, for it is really much more fix'd than any one, not verſed in theſe things, wou'd be aware of. How different now is the effect of various Acids, with regard to their production of Colours? With the greateſt degree of Fire this white Colour is not altered, which happened ſo eaſily with Spirit of Nitre. This white Powder, by Calcination, becomes extremely corroſive, and hence poiſonous. But in what a ſingular manner does this acquire a new Colour, by only coming into contact with Water? For if this Powder prepared in a right manner, is but expoſed to the open Air, its ſurface in a ſhort time becomes yellowiſh, with the moiſture it attracts out of it. This Powder ſeems to be the Medicine, by the prudent uſe of which, *Paracelſus* performed ſuch very extraordinary cures. This appears from that little Treatiſe of his called *Noſocomium*, and is ſufficiently confirm'd by *Oporinus*, who tells us that he frequently made it. But he rendered it milder by burning Spirit of Wine upon it according to the method of the ancient Chemiſts, who uſed by this means to free metalline *Calx's* from the Salts that adhered to them externally, and hence were too acrid, leaving thoſe only behind that were combined more intimately. The judicious *Sydenham*, who was very ſparing of his commendations of the Chemiſts, gratefully acknowledges in his Treatiſe *De Lue Venerea*, that by the help of this Medicine, ſome Diſeaſes are cured, which are otherwiſe inſuperable. The great *Boyle* tells us too, that by uſing it as a Sternutatory in a gentle doſe, the whole Body has undergone ſuch an alteration, that Cataracts have been truly reſolved by it. And a Woman formerly at *Paris*, is ſaid with it to have cured Perſons whoſe caſes were quite deſperate. This Medicine therefore is a match for ſtubborn Diſeaſes, but requires the direction of a ſkilful Head, nor ſhould be made uſe of, except when the Malady won't yield to gentler Methods. In Dropſies it is not leſs efficacious, nor in venereal Diſorders of the Glands. *Van Helmont* ſays, that the Oil of Vitriol, by ſimple contact with the Mercury, is converted into Alum; but this ſure is either talking improperly, or not conſiſtent with truth. But when that famous Man orders the Fire of Vitriol of Copper to be pour'd upon the red Precipitate of *Joannes a Vigo*, and to be thence diſtill'd in order to prepare the purging *Arcanum* of *Paracelſus*, then certainly, if I underſtand any thing of the matter, we ſhall have the ſame Medicine we have here: For if by the Fire of Vitriol of Copper, he means an exceeding ſtrong Oil of Vitriol, then as ſoon as ever this is poured upon the red Precipitate, it immediately diſlodges the Spirit of Nitre from the fix'd Mercury, and renders it volatile, and at the ſame time taking poſſeſſion of its place itſelf, produces ſuch a *Calx* of Mercury as we are here talking of; and when from this the Water of the Whites of Eggs is diſtilled ſome number of times, the external Acid is ſeparated, and the Powder becomes milder, and yet works very well, and often effects what is ſcarcely within the power of any thing elſe. If by Fire here, however, we are to underſtand ſomething elſe of a more ſubtil nature, I confeſs, I know nothing of the matter; but by comparing *Helmont* and *Paracelſus* together, I think it is no more than what I have mention'd: This you yourſelves may examine. Metals now, when they are alone, act very little upon our Bodies, except by their ſize, ſigure, and weight; but by being combined with exceeding acid Salts, they acquire new powers that are frequently very ſurprizing, and very various according as the Acids are more intimately fix'd within them, or adhere to them more externally. In form of a Vitriol they act exceeding violently. If this is calcin'd, the *Calx* grows by degrees more and more mild; and indeed, by a ſtrong, and long continued Calcination, as the Acids are gradually expell'd, the roughest Preparations of this kind become mild, as happens even in Turbith itſelf: But at the ſame time that their Operation is gentler, it becomes proportionably leſs efficacious; and hence thoſe Chemiſts and Phyſicians have been miſtaken, who obſerving the wonderful effects of Turbith, but ſeeing it work violently, have endeavoured to ſoften it, which is eaſily done, and then expected the ſame good from it, when it was mild, as they had before experienced when it was rough. The Methods now of mitigating its Acrimony, are ſeparating its Acid, by waſhing it thoroughly with Water; by Diſtillation of ſimple Water from it, repeated a good many times, and always to a dryneſs; by treating it in the ſame manner with Alcohol; by burning Alcohol upon it; by rubbing it with a good deal of a metalline Matter as in the Preparation of *Mercurius Dulcis*; by the addition of alcaline Salts, which abſorb the Acid out of Metals calcin'd with Acids; by grinding it with Chalk, *Lapis Cancrorum*, Oyſter-ſhells, or the like ſubſtances which are true Sponges to Acids; by calcining it with a ſtrong Fire, and for a long time; and laſtly, by fixing it in the Fire, by beginning with a gentle degree, and gradually increaſing to as great a one, as the Glaſs will bear without melting.

PROCESS CC.

An igneous Oil of Mercury.

APPARATUS.

UPON Mercury calcined with Oil of Vitriol into a ſnowy dry *Calx*, according to the preceding *Proceſs*, and grown cold, I pour in this clean Urinal an equal quantity of Oil of Vitriol. I boil then to a dryneſs as before, uſing all poſſible caution to keep clear of the Fumes; and I find that it is now dried with more difficulty than it was before, requiring both a ſtronger Fire, and a longer time to effect it. When the Powder at laſt becomes dry, I add again the ſame quantity of Oil of Vitriol, and proceed as before, and by this means it will at laſt ſcarcely be dried by an intenſe and long continued Fire, but begins to remain in form of a fix'd Oil, which is vaſtly corroſive and cauſtic, ſo as to be perfectly intractable, like *Paracelſus*'s Infernal Fire. The Mercury, therefore, by this management, becomes ſo fix'd with the Oil of Vitriol, that it will not riſe with a prodigious Heat.

USE.

THIS *Proceſs* ſerves to demonſtrate the impregnation, ſaturation, and inceration of Metals by Acids, to any degree, as well as the fixation of volatile Mercury by Acids, as far as it is poſſible. By this means, however, it will never be converted into any Metal; for let Mercury be render'd ever ſo fix'd by Acids in the moſt artful manner poſſible, do but grind it with twice as much Filings of iron, and then diſtill the Mixture in a glaſs Retort with the greateſt ſand Heat, and the Mercury will be ſet at liberty, and recover its original form, the Acid being attracted into the Iron.

PROCESS CCI.

Æthiops of Mercury.

APPARATUS.

TO 1 drachm of the choiceſt Flowers of Sulphur, in a glaſs Mortar, add 3 drachms of Mercury, and rub them well together for a good while, and the Mercury will begin to vaniſh, the Sulphur at the ſame time acquiring a greyiſh Colour: Proceed in this manner, and the Mercury will intirely diſappear, and you will have a black Powder, which will be proportionably more ſo, as it is longer rubb'd. By this method you may eaſily prepare what quantity of it you pleaſe. When this Preparation has ſtood by ſome time, it hardens ſpontaneouſly into a ſolid black Maſs, which however may, by rubbing, be eaſily reduc'd again to a Powder.

USE.

HERE then we ſee how eaſily, by a ſimple mechanical attrition, Mercury is combin'd with crude cold Sulphur, and that in ſuch a manner, that the union becomes conſiderably ſtrong, nor to be afterwards very eaſily diſſolv'd. The Powder prepar'd in this manner, is inodorous, inſipid, by no means acid, nor is it diſpos'd to be intimately mix'd with any thing. When it is taken into the human Body, it is not capable of entering either the venous, chyliferous, or lymphatic Veſſels, but being carried on directly through the Inteſtines, paſſes off by Stool, and perhaps in its paſſage may deſtroy Worms. Every perſon therefore, I imagine, will be deceived, who expects any better effects from it, which I have never yet been able to obſerve. And I can't but think, that thoſe Perſons act ſomewhat imprudently, who order ſuch large quantities of this foſſil Matter to Infants, and People of very tender Conſtitutions, as it is foreign, and not to be ſubdued by their natural powers, and is ſo much the more to be ſuſpected, as it is of a more ſluggiſh nature, and remains longer in the Body. Who knows the effect of a ſubſtance, which ſo long as it remains compounded, don't ſeem more active than any other heavy inſipid Earth? That the Acid of the Sulphur, now, is not attracted from the oily part into the Mercury in this Operation, we are ſufficiently convinced, as there is nothing produc'd by this means but a homogeneous, inſipid, inert Maſs, that diſcovers no degree of Acrimony at all.

PROCESS CCII.

Factitious Cinnabar.

APPARATUS.

I Take 4 ounces of the beſt Flowers of Sulphur, and putting them into a tall earthen Veſſel that runs out into a rim at top, melt them with a clear gentle

Fire, taking care that the upper part of the Veſſel ſhall be at a conſiderable diſtance from the Fire, for fear it ſhould ſet fire to the Sulphur, which lights with a vaſt deal of eaſe when it is in fuſion. This being done, I take 12 ounces of Mercury made hot, but not to ſuch a degree as to begin to fume, and by means of a Veſſel with a ſpout to it, pour a little of it into the melted Sulphur, which immediately begins to grow ſomewhat tenacious. I then keep them conſtantly ſtirring with a thick Tabacco-pipe, and pour in the Mercury a little at a time, till the whole is made uſe of, and intimately mix'd with the Sulphur. There then uſually ariſes a great hiſſing with denſe red Fumes, and the Matter takes fire with a conſiderable noiſe. Cover the mouth of the Veſſel with a Tile, and let the whole grow cold, and you will have a black Maſs.

2. This, which is like the Æthiops of Mercury, *Proceſs* 201, put into a *Heſſian* Cucurbit, and lute on an Alembic very cloſe with a Lute made of Clay and Lime, or elſe cover it with an inverted Cucurbit ſmall enough to ſtand in the mouth of the former. Set the Cucurbit in a ſand Furnace, taking care that the bottom of it ſtands upon the iron Pot, and that the Sand about it riſes a little higher than the included Matter. Raiſe a Fire gradually, from the gentleſt degree to the greateſt, and there will firſt come off a ſmall quantity of an inſipid Water; then a few whitiſh Flowers; and at laſt ſomewhat black. When the Fire has been kept up at its height for the ſpace of three hours, let the whole gradually cool, and you will find a denſe ſubſtance adhering to the ſides of the Cucurbit, which will be blackiſh on the outſide. Take the maſs out, and bruſh off the black with a Hare's Foot, and then when it is reduc'd to Powder, it is of a ſcarlet Colour, and is called Factitious Cinnabar. At the bottom of the Cucurbit there will remain ſomewhat of *Fæces.*

U S E.

HERE then we at firſt have an Æthiops by Fire, as we had by rubbing in the preceding *Proceſs*. The Cinnabar is the Mercury and Sulphur combin'd together by Fire into the form of a ſimple Foſſil, ſuch a one as we find prepared by nature in a great many Mines, without any conſiderable difference. Its vertues in the human Body are nearly the ſame with thoſe of the Æthiops. The great *Crato* indeed calls it the *Magnes Epilepſiæ*, but for my part, I never ſaw any ſuch extraordinary effects from it. If it is join'd with Purgatives, then it is carried ſooner through the Inteſtines, and does no more than we mention'd of Æthiops *Proceſs* 201. If it is mixed with Pomatum, it makes a Coſmetic that gives a red Colour. It is uſed for Fumigations in venereal Diſorders of the Noſe, Mouth, and Throat, but frequently with little, and often with unhappy ſucceſs. The Mercury may be recovered again from the Cinnabar exceeding pure, by only rubbing it with twice as much Filings of Iron, and then diſtilling with a Retort into Water with the ſtrongeſt ſand Heat.

PROCESS CCIII.

An Amalgama *of Mercury with Lead, and other Metals.*

APPARATUS.

1. MELT ſome pure Lead in a clean iron Ladle, and then put into it an equal quantity of hot Mercury, and ſtir them about with an iron **Rod.** Let them grow cold, and you will have a homogeneous Maſs of a ſilver Colour, which will be conſiderably hard, but by rubbing will grow ſofter and ſofter. Put this Maſs into a glaſs Mortar, rub it, and then add to it what quantity of Mercury you pleaſe, and it will mix with it as Water with Water.

2. An *Amalgama* of Tin you may prepare too exactly in the ſame manner, and this likewiſe may be diluted by the addition of more Mercury.

3. Take a ſolution of the beſt Copper in *Aqua Fortis*, ſaturated to that degree that it is capable of diſſolving nothing more, dilute this with 12 times as much clean Water, heat the Liquor, and put into it plates of poliſh'd Iron, and the Copper will be precipitated to the bottom in form of a Powder, and the Iron will be diſſolv'd: Proceed in this manner till all the Copper is precipitated: Pour off the Liquor at top, and waſh the precipitated Powder with hot Water, till it is grown perfectly inſipid. Dry the Powder thoroughly, put it into a glaſs Mortar, and by rubbing, mix with it an equal quantity of hot Mercury, and you will have an *Amalagma*, in which the Copper will be combin'd with the Mercury, and which may then be diluted by a farther addition of it. An *Amalagma* of Copper in any other manner, upon trial, you'll find ſufficiently difficult.

4. Pure Silver, precipitated from *Aqua Fortis*, may in the ſame manner be reduced to an *Amalgama*, as I took notice in our Hiſtory of Silver, to which therefore I refer you.

5. Diſſolve the pureſt Gold in *Aqua Fortis*, till it will take up no more; dilute the Solution with 12 times as much pure Water; put into it ſome Plates of poliſh'd Copper, and a Powder of Gold will be precipitated to the bottom, and upon the Copper. Let it ſtand hot till the Copper you put in will be no longer affected, ſhake the Plates that all the Gold may fall to the bottom, pour off the Liquor at top, waſh the precipitated Powder with Water, dry it, and then in a glaſs Mortar you may reduce it to an *Amalgama* with Mercury, and afterwards dilute it with more as you pleaſe. Or take a mixture of Gold and Silver, coppel it with Lead, and by means of a good aſſaying *Aqua Fortis*, ſeparate the Silver. Then waſh the black Powder of Gold that remains at the bottom, dry it, and whilſt it is hot, rub it with Mercury, and it will preſently be reduced to an *Amalgama*, which will bear dilution as before. All *Amalgama's* now are white, prepare them from whatever Metal you pleaſe.

USE.

BY theſe methods then, you may, without any loſs, make an *Amalgama* from all Metals but Iron. There are other ways of doing it likewiſe, but not without loſing a good deal of your Mercury, and being in danger from the

Fumes. Hence we ſee that Mercury is the true ſolvent Water of Metals. Theſe now, when they are thus reduced to an *Amalgama*, may be mix'd and blended together, and lie concealed among one another. This ſolution of Metals by Mercury, I look upon to be the *Baſis* of Alchemy. Hence ſome of your avaritious Trickſters adulterate Mercury with Lead; but by exhaling a grain or two of it, the cheat is eaſily diſcovered. And hence perhaps happens the coagulation of Mercury, aſcrib'd both by *Paracelſus* and *Van Helmont*, to the fixing fume of Lead, and a wonderful fixing metalline Spirit: For if you melt ſome Lead, and when it is beginning to cool, but is not harden'd, you make an impreſſion on the ſurface with a Stick, and gently drop a little cold Mercury into it, in a ſhort time it will acquire a ſolid conſiſtence. But does not this happen from the hot Lead's being receiv'd into the Mercury, and ſo amalgamated, and of conſequence forming a pretty hard Maſs? Certainly, if you'll take a little of this fix'd Mercury, and putting it into a ſmall Veſſel, expoſe it to the Fire, you'll be convinc'd. This Art now, of making *Amalgama's*, has given riſe to a common Cheat; for if you combine Gold or Silver with Mercury in this manner, by only adding Lead to them in the Fire, you may recover them again, and thus make a plauſible ſhew of producing theſe Metals. But only take a little of this Mercury, put it into an iron Ladle, and ſet it on the Fire, and then the Mercury flying off, and leaving the Metal, will at once diſcover the fraud. On theſe principles depends the Art of gilding with Gold and Silver.

PROCESS CCIV.

The Ablution of Metals by Mercury.

APPARATUS.

TAKE an *Amalgama*, rub it in a glaſs Mortar, the longer the better, and it will begin to grow black. Pour clean Water upon it, and continue to rub it and the Water will grow black and turbid. Pour this out, add more Water, and rub again, and this will be changed as the former. Repeat this till the laſt Water, after rubbing, remains clear. You will then have a pure *Amalgama* that looks like Silver. And here all *Amalgama's*, treated in this manner, make the Water thus black, more or leſs, that of Gold however leaſt of all. The Powder that comes away, when it is dried, is neither found to be Mercury nor Metal. In the other Metals try if you can find any end to this work: I am apt to believe you ſcarcely will.

USE.

HENCE we learn that pure Mercury, by being mixed with Metals, becomes ſo united with them, that ſomething which lay concealed in one or both of them before, is now by this means expelled. If in this manner you procure a good deal of this Powder from Gold and Silver, as the Matter both of one and the other remains exactly the ſame in Weight, without the leaſt addition or diminution, the Powder muſt neceſſarily in this caſe be produced from the Mercury. But this is a matter of deep ſpeculation, concerning which I hope to publiſh my thoughts elſewhere, and therefore here I add nothing farther.

PROCESS CCV.

The Solution of Gold.

APPARATUS.

TAKE of *Aqua Fortis* 4 parts, of the pureſt Sea-Salt 1 part, mix them together, and you will have a yellow Liquor. Pour this into a clean Urinal, put into it of the pureſt Gold beat into Plates 1 part, ſet the Urinal upon the Fire, that they may be thorough hot, and the Gold will diſſolve. Then throw in 2 or 3 grains of Gold at a time, till at laſt, whilſt it ſtands thus hot, ſome part remains undiſſolved. Then pour out the Liquor, and you will find it of a golden Colour. If there remains nothing black at the bottom, it is a ſign there was no Silver intermixed with the Gold; for if this had been the caſe, it would have precipitated in form of a black Powder. This then is a ſolution of Gold, which will be brought about by every *Aqua Regia* prepared in what manner ſoever you pleaſe, as we have taken notice, and explained already.

USE.

HENCE we ſee the reaſon of the name *Aqua Regia.* If this Solution touches the Skin, it changes it of a purple Colour. It is cauſtic, and taken internally has a poiſonous quality. By a fixed or volatile alcaline Salt the Gold is precipitated, and falls all to the bottom. If the Powder is then thoroughly waſhed and dried very carefully with a gentle Heat of 80 degrees, it will weigh more than the Gold that was diſſolved. If you heat this gradually, when it comes to be hot to a certain degree, it on a ſudden is diſcharged with a great report, and diſappears. Hence it is called *Aurum Fulminans*, or *Aurum Tonitruans.* This now is a ſurprizing *Phænomenon*, nor explicable, as I conceive, either *a priori*, or by analogy; at leaſt all the endeavours hitherto to explain it, appear to me to be inſufficient. When this has gone off in this manner in a very large glaſs Veſſel, there has a vaſtly ſubtle Powder of Gold been recovered from it. They who under the notion of an *arcanum* have given it internally, at extravagant prices, promiſing extraordinary things from it, have brought great Pains, Gripings, and other Diſorders upon their Patients. What beautiful diſcoveries therefore may be made in the chemical Art that do no manner of ſervice to Phyſick?

IV. Upon SEMI-METALS.

I. *Upon ſaline ones.*

PROCESS CCVI.

The Analylis *of Vitriol, or Reſolution of it into a Spirit, Oil, and Colcothar.*

APPARATUS.

1 TAKE of the common green *Goſelar* Vitriol 8 pounds, put it into two earthen Long-necks, each of which will hold 4 pounds, cover both of

theſe

theſe with a Tile, and ſet them upon the Hearth under the Chimney. Place Fire round them, that they may grow gradually hot quite through, and the Vitriol will begin to fume. Bring the Fire nearer, and increaſe it, and then the Vitriol will melt, and become liquid, but upon raiſing it ſtill higher, it will thicken, and acquire a greyiſh Colour. Then place the Fire all about the Long-necks in ſuch a manner as quite to ſurround them, that the included Matter may grow yellowiſh, and about the Sides begin to grow reddiſh. When you ſee this is the caſe let the Fire go down, and you will find the Long-necks ſplit. Take out the Vitriol, and reduce it to Powder, which will be of a yellowiſh Colour. This then is the Calcination of Vitriol, for the Diſtillation of the Spirit, and Oil. And this indeed is very convenient, for otherwiſe in order to ſeparate the Phlegm ſafely, the Operation will be exceeding tedious, or elſe by its riſing hot the Receiver will be broke; and then the diſtilling Veſſel being preſs'd by the melted Matter, will be cracked likewiſe. Hence the Vitriol muſt be calcined till it won't any longer melt in the Fire. In this firſt part of the Operation there is generally loſt 5 pounds out of the 8.

2. Take the remaining 5 pounds of Vitriol, thus calcin'd, put it into a ſtrong earthen Long-neck that is big enough to contain twice the quantity, and place it in the ſame Furnace that is uſed for drawing Spirit of Nitre, and Salt, which, together with the Long-necks, you'll find deſcribed in the Diſtillation of Spirit of Nitre, and Spirit of Sea-Salt, with Bole. When this is well ſecured in the Furnace with Bricks and Mortar, fix a cylindrical Segment into the Mouth, and with a ſtiff Lute made of Clay and Lime, very cloſely ſecure it all round. About the other end of the Segment wrap a wet Cloth, and then inſert that into a very large glaſs Receiver, taking care that it fits it as exactly as poſſible, and does not go in above two inches. And here you muſt take care that the axis of the Receiver, the cylindrical Segment, and the Long-neck are in the ſame right line, for fear either the Neck of the Receiver or the Segment ſhould be broke. Let this laſt Joint be clos'd as nicely as poſſible with the ſame Lute as the former, and then wrap round it a Cloth daubed with the ſame. This being done, let the whole be left four and twenty hours, that the Lute may be dried.

3. Raiſe a Fire with exactly the ſame cautions as you find given *Proceſs* 141, 144, and there will firſt come off a white Fume, and the Receiver will grow hot, upon which keep up the Fire in the ſame degree for the ſpace of ſix hours. Then increaſe it, and there will begin to appear *Striæ* of Spirits, running like an Oil down the ſides of the Receiver; proceed with this Fire for ſix hours more. And laſt of all urge the Matter another ſix hours, ſo that the Long-necks ſhall be all the time perfectly red hot all over, and you will then have the laſt thick Oil. And here if any Vapour perſpires through the Lute, you my cover the Crack with a little bit of Cloth, daub'd over with the ſame, and made hot, and by this means it will be ſufficiently ſecured. Continue, now, your Operation ever ſo long, you will always find a Vapour coming off, though the Liquor it produces won't pay for the trouble and Charge, and therefore I think it ſhould not be protracted above eighteen hours. Let the Fire then gradually ſink, till the middle Segment has not much Heat in it, and the Receiver is grown intirely cold.

4. Have by you a Bottle with a large bottom, and narrow Neck, with a pret-

ty large Funnel ſtanding in it. Very cautiouſly wet the Cloth and Lute about the Mouth of the Receiver, and when it is ſufficiently moiſtened, draw it off very gently in a horizontal direction, for fear of cracking it, and take care that the Fumes don't come at you, nor any of the Lute fall into the Receiver. When it is off, wipe the Neck of the Receiver, and then cautiouſly inverting it, pour the Liquor into the Funnel, and ſo into the Bottle, which ſtop cloſe, and ſet the Receiver by for the ſame uſe another time. By this method then I generally have 21 ounces of a black, thick, ſtrong, fuming Oil of Vitriol, there remaining in the Long-neck a light, powdery, rough, red *Calx*, ſomewhat blackiſh, to the quantity of 52 ounces; ſo that 7 ounces are diſſipated and loſt.

USE.

IN this manner then is drawn Oil or Spirit of Vitriol, which is of very great and extenſive uſe both in Chemiſtry and Phyſick; for it is the moſt powerful, heavieſt, and moſt antiſeptic Acid, but a cauſtic one. Vitriol therefore conſiſts of this Acid, Colcothar, and the Phlegm that was firſt expelled in the Calcination of it. This Oil of Vitriol cannot be brought to boil with a leſs Heat than one of 600 degrees. If it is put into a clean glaſs Cucurbit, and urged with a Sand Heat of 500 degrees, it gives out a ſylveſtrian, ſuffocating Spirit, and a Water, and then from black it becomes limpid, exceeding heavy, and igneous, and if it is poured into a wet glaſs Veſſel, it inſtantly produces ſuch a Heat, as to make it fly, and like a Magnet attracts the Water out of the Air. If you take 4 ounces of this Oil, put it into a clean ſmall Retort that has a long Neck, very much bent, and diſtill with a Sand Heat, directing your Fire in ſuch a manner that there ſhall be about 6 ſeconds betwixt the Drops, which muſt fall into clean Water in the Receiver, then you will have an exceeding pure Oil of Vitriol, which will be as good as Spirit of Sulphur *per Campanam:* But this requires a ſkilful Operator. Every drop, as it falls into the Water makes a hiſſing noiſe, as if it was Fire. If one of theſe Drops falls upon the bare Glaſs, it immediately flies with the Heat of it, as if it were cut with a Diamond. And if you urge it with too ſtrong a Fire, you break the Neck of the Retort, and loſe your labour, and there exhales a pernicious ſuffocating Vapour. If ever therefore there is caution neceſſary, it is here. But otherwiſe this is an elegant *Proceſs*, both with regard to the nicety, and the uſe of it, as by a prudent practice in the chemical and medicinal Arts you yourſelves may experience. *Paracelſus* tells us, the beſt method of preparing this Oil is to diſtill the Vitriol in a *Heſſian* Veſſel to a dryneſs, and then pour the Liquor back again upon the *Reſiduum*, and draw it off again, and to repeat this a great number of times, the oftner the better. And then he promiſes you, that you will have a Liquor that is greatly uſeful if it is uſed with judgment. But here you muſt take care that the Veſſel is not broke by the too great quantity of the calcined Vitriol, which is guarded againſt by making uſe of but a ſmall quantity at a time in proportion to the Veſſel.

PROCESS CCVII.

Ens Veneris.

APPARATUS.

1. TAKE the Colcothar that remains in the preceding *Proceſs*, put it into a large Crucible, which cover cloſe with a Tile, and place in the hotteſt part of the Furnace, *viz.* under the Chimney, where there will ſome more Oil of Vitriol ſtill be expelled. Let it be kept thoroughly red hot during the whole time, and by this Calcination the Colcothar will become exceeding red. Boil it in Water in a glaſs Veſſel, ſtirring it well about, let it ſettle, pour off the Liquor at top, filter it boiling hot, and it will have the Taſte of Vitriol. Upon the *Reſiduum* pour more Water, boil, decant the Liquor, and throw it away, and ſo proceed till the laſt Water, by being boiled with the Colcothar, will acquire no manner of Taſte. You will at laſt then have remaining a fine red Powder, which keep under the title of a *ſweet* Calx *of Vitriol.* If the firſt Liquor, after it is rendered pure by Filtration, is inſpiſſated, it will yield a kind of yellow Vitriol, whence we learn what a ſurprizing Body Vitriol is in regard of its fixity in the Fire, even in the ſaline part of it.

2. Take of the ſweet *Calx* of Vitriol, and the drieſt Flowers of *Sal Ammoniac*, of each equal parts, put them into a hot glaſs Mortar, and with a glaſs Peſtil rub them very ſtrongly, and for a good while, till they are thoroughly mixt and work'd together, taking care at the ſame time that they don't acquire any moiſture, for which reaſon this ſhould be done on a clear dry day, and in a hot place. Put this Powder into an earthen Cucurbit, not too high, fix on a broad Alembic with a wide Beak, hang on a ſmall Receiver, and then place the Cucurbit in a ſand Furnace, ſo that the bottom of it ſhall almoſt touch the iron Pot. Then cover the Cucurbit with Sand to half its height, and give a gradual Fire. In the firſt place then there will come off an acrid, volatile, yellowiſh Liquor, of an intolerable Smell, and a very corroſive, igneous Taſte, nearly as it happen'd in the ſublimation of Iron, *Proceſs* 169, for the phyſical *Ratio* is pretty much the ſame. The Fire being increaſed after the Liquor is expell'd, there riſes into the Alembic ſome white Flowers, then yellow ones, and in a ſhort time exceeding red ones. Keep up the Fire for the ſpace of 6 hours, and at laſt let it be ſo ſtrong as almoſt to make the Pot red hot. Then let the Fire ſink, and you will find in the Alembic, and about the upper part of the Cucurbit, a ſublimate of a very beautiful red Colour, which is ſalt and aſtringent, and very much like Flowers of Iron. This being carefully taken out, and put immediately into a dry Vial, you will have at the bottom of the Cucurbit a red Matter of a rough Taſte, which in the Air readily puffs up, and in ſome meaſure diſſolves. It is neceſſary however to obſerve here, that theſe productions will be different, according as you make uſe of Vitriol of Copper, or Iron.

USE.

THE moſt fix'd metalline part of the Vitriol, by the aſſiſtance of the *Sal Ammoniac*, and the Fire, is here render'd volatile. And the qualities of the Iron in the Flowers prepared from this calcined Vitriol, are nearly the ſame as in thoſe made from the crude Iron, *Proceſs* 169. This Preparation, therefore, if we muſt uſe theſe terms, ſhould rather be called the *Ens primum Martis*, and that from the blue Vitriol, the *Ens Veneris*. Hence then we underſtand the death and reſuſcitation of Metals, talked ſo much of by *Paracelſus*. One grain of this Sublimate turns a large quantity of an Infuſion of Galls into Ink. Mr. *Boyle* promiſes prodigious things from this Medicine, in thoſe Diſorders that ariſe from too great a laxity and weakneſs of the ſolid *Stamina*, as in the Rickets, and the like; and there it is of great ſervice. And hence *Helmont*, in his Treatiſe called *Butler*, ſays a great many pretty things of ſomething of the ſame nature. Since we ſee now, that after the extremeſt torture of the Fire, ſuſtain'd both in a cloſe and open Veſſel, there ſtill remains ſomething vitriolic here, it is no wonder at all that Vitriol will continue to emit Fumes, tho' you diſtill it ever ſo long. This wonderful Body certainly deſerves the moſt careful examination.

II. *Upon ſulphureous Semi-Metals.*

PROCESS CCVIII.

The Solution of Antimony in Aqua Regia.

APPARATUS.

TAKE of the pureſt Antimony, collected from the tops of the Cones, half a pound, reduce it to Powder, and put it into a glaſs Veſſel that is low and pretty large, and cut off in ſuch a manner, as to have a wide Mouth. Set the Veſſel with the Antimony under a Chimney that will carry the Fumes up without diſſipating them, and then pour upon it half a pound of *Aqua Regia*. By this means there will be excited an incredible Efferveſcence, with a prodigious Heat, Noiſe, and very red and denſe Fumes, all which will ſoon be over. There will then remain at the bottom a moiſt, thick, pappy Matter, of a greyiſh and yellowiſh Colour. Dry this with a very gentle Fire, keeping it now and then ſtirring with a Stick.

USE.

THIS is called an immerſive or humid Calcination of Antimony, by which this Foſſil, which before was neither emetic, nor purgative, acquires the moſt virulent qualities. The yellow Matter interſperſed through this *Calx*, is a true Sulphur of Antimony, which the Acid not being able to diſſolve, is diſcharged from the other metalline part of the Antimony, which is corroded by the *Aqua Regia*. Hence therefore in this Operation, there is both a Calcination and Separation. This *Proceſs* is neceſſary to thoſe that follow.

PROCESS CCIX.

True Sulphur of Antimony.

APPARATUS.

UPON the *Calx* of the preceding *Proceſs* pour ſome clean Water, ſhake them together, and pour off the turbid Liquor into another Veſſel; add more Water, ſhake and decant as before, and proceed in this manner till the yellow, lighter part being thus diſperſed through the turbid Waters, is ſeparated from the heavier metalline one. Mix the decanted Waters together, pour off the whitiſh Water at top from the ſulphureous Matter that falls to the bottom, which dry with a very gentle Fire, and it will be a true Sulphur in every character. If you put larger lumps of Antimony into *Aqua Regia*, and ſo perform the Solution, then the Maſſes of Sulphur will be larger; for the *Aqua Regia* penetrating to the bigger portions of the Metal that lie concealed in the Sulphur, will diſſolve and extract them, and ſo render the Maſſes of Sulphur more remarkable.

USE.

HENCE then it appears how intimately Sulphur may lie concealed under the appearance of a ſhining Metal; and how ſurprizingly the *Aqua Regia* can find out the metalline part amongſt the Sulphur. But how wonderfully does the Sulphur here retain its proper nature without any alteration? This is that Sulphur of Antimony which *Van Helmont* orders to be extracted, and which he ſays ſcarcely differs from the common, except that it is a little more upon the greeniſh; and indeed there is hardly any difference. Nor perhaps does the Cinnabar that is made with it, in regard of its Vertues, deſerve ſo much trouble: Certainly, the ſubliming it ſeven times, as he directs, is not ſo eaſily done as directed. In this Operation, however, we have an ocular demonſtration, that Antimony conſiſts of a ſulphureous and a metalline part.

PROCESS CCX.

Glaſs of Antimony.

APPARATUS.

1. TAKE of the pureſt Antimony reduced to Powder 2 pounds, put it into a large earthen Diſh that is not glazed, and in the open Air place it over a Fire, in ſuch a manner, that the Powder ſhall fume, but not melt. On hitting this nicely depends the whole Operation. Keep the Powder continually ſtirring with an earthen Rod, and there will riſe a white, thick, fetid Fume, which is prejudicial, and therefore muſt be cautiouſly avoided by the Operator's ſtanding ſo that the Wind ſhall blow it from him. Carefully continue this Calcination in an equable manner till the Matter fumes no longer. Then increaſe your Fire a little, and if it begins to fume again keep it up till it ceaſes, and then make your Fire pretty ſtrong till the Diſh begins to be red hot, and the

included Matter emits no more Fumes, and you will by this means have a *Calx* of a greyiſh Colour. If you proceed to calcine this with a ſtill greater degree of Fire, till the Powder grows red hot likewiſe, you will then have a yellow *Calx*, which is more purified from the volatile part. If in the beginning of the Operation your Fire ſhould happen to be ſo ſtrong as to melt the Antimony, and make it run into Lumps, you muſt immediately ſlacken your Fire, and reduce theſe again to Powder. This is the calcination of crude Antimony by means of Fire alone, and it is of great uſe.

2. Put this *Calx* into a Crucible, round which place fire at a diſtance, gradually bringing it nearer and nearer, that the Crucible may gently and equably grow warm, hot, very hot, and at laſt red hot, it being all the time cloſe covered with a Tile, that no Coals or Aſhes may fall into it. Increaſe your Fire till the *Calx* is put in fuſion, in which ſtate let it ſtand for half a quarter of an hour, and then pour it out upon a very hot, dry Marble, and you will have a brittle, ſub-pellucid, hard Cake, of a dark yellow Colour, which is called Glaſs of Antimony, and is ſo much clearer, as it ſtands longer in the Fire.

USE.

ANTIMONY conſiſts of common Sulphur (*Proceſs* 209), and a metalline glebe. All the Sulphur becomes volatile by the Fire made uſe of for this calcination (*Proceſs* 150), but the metalline part bears a melting Fire, as appears when it is melted into Cones, but then it always yields a white ſuffocating Fume. Hence then we underſtand, that when Powder of Antimony is uſtulated with ſuch a Fire as is not able to melt it, then the external Sulphur is gradually expelled, by which means the metalline part is purified, and at laſt is converted into a torrified *Calx*, which, though the Antimony was harmleſs before, is a moſt virulent emetic. How this ſhould happen, now, is not hitherto well explained. This *Calx*, being put in fuſion, is Antimony converted into Glaſs, as we formerly ſaw in Lead. And indeed the Adepts ſay, that there is a great Agreement betwixt Lead and Antimony, which is confirmed by the melting this *Calx* into Glaſs. This is almoſt a fatal Emetic. And why? If it is infus'd in a ſoft Wine, not too acid, it yields an Emetic with very little loſs of its Subſtance. The Vertue however may be pretty ſoon drawn out by repeating the infuſion. This makes the emetic Wine every where ſufficiently known. This Glaſs of Antimony conſumes almoſt all metalline Bodies in the Teſt, but to Gold it gives a beautiful Colour.

PROCESS CCXI.

A Regulus *of Antimony with Salts.*

APPARATUS.

1. A *Regulus* is procur'd from Antimony by every method in which the metalline part is ſeparated from the ſulphureous one; and the more accurate this ſeparation is, the purer always is the *Regulus*. In order to this then, the foſſil Antimony in its native Glebe, is ſometimes put into conical earthen Pots, and melted with a moderate Fire that only makes it lightly red, and thus is formed into Cones, the

lower parts of which, or thoſe towards the *Vertex*, are heavy, purer, and more metalline, whilſt the broader parts towards the Baſe, are leſs ſolid, darker, and more ſulphureous. In this manner is Antimony depurated to a *Regulus* by Fuſion alone.

2. Take of common crude Nitre 2 parts, of good Tartar 3 parts, and of pure Antimony 4 parts, dry theſe well, and ſeparately reduce them to a fine Powder, and whilſt they are exceeding dry, by rubbing, mix them intimately together. Make the Mixture moderately hot, by all means very dry. Take a large Crucible, heat it gradually in the Fire till it is perfectly red hot, and then throw into it 2 drachms of this dry, hot Powder, which will take fire violently, and with a great noiſe, and throw out Sparks on every ſide. When every thing is quiet, throw in the ſame quantity more, and you will again have the very ſame *Phænomena.* Proceed in this manner till you have conſumed all your Powder. And here the following cautions are abſolutely neceſſary: Let the Crucible be a large one, that the Matter, when it is violently agitated, may not run over: Throw in but a little at a time, leſt the Mixture, when it takes fire, ſhould fly in large Sparks out of the Veſſel: Let the preceding portion be always thoroughly on fire, come to reſt, and be perfectly red hot before you throw in another, for fear the matter being hotter underneath, and colder at top, ſhould form a Cruſt, under which the Fire being confin'd, wou'd cauſe an exploſion much louder, and more violent than that of a Canon; for you have here a true *Pulvis tonitruans*, from the Nitre, Tartar, and Sulphur of the Antimony: And laſtly, let the Crucible be thoroughly red hot for fear of the ſame terrible accident. If a young Beginner, not aware of theſe things, goes about to make a *Regulus* according to the common directions, he runs a riſque of his Life; if he obſerves theſe cautions, he may perform the Operation ſafely. After the detonation is compleated in the manner deſcribed, cover the Crucible with a Tile, and increaſe your Fire till the Matter flows like Water. Have by you at the ſame time a metal melting Cone, perfectly dry, a little warm, and rubb'd over on its inſide with Tallow, into which pour the melted Matter with one ſtream, and immediately ſtrike the Cone. Upon pouring in the Matter, a ſudden Flame will burſt out from the lighted Tallow. Let the whole ſtand quiet and cool, and then invert the Mould, and with a Hammer ſtrike it at the Baſe, and the Cone will drop out, the lower or vertical part of which will be the metalline part of the Antimony, whilſt that towards the Baſe will conſiſt of the Salts and Sulphur. The upper ſurface of the metalline Maſs, where it is cover'd with the *Scoriæ*, will be mark'd with the figure of a Star. The *Scoriæ* will melt, and puff up in the Air.

USE.

AS this *Proceſs* diſcovers to us the true principles of the metallurgic Art, it is worth while to conſider it a little attentively. In *No.* 1. then, the foſſil antimonial Glebe being melted with a proper Fire, becomes liquid and heavy: Hence the lighter Bodies that are in it, as Stones and the like, and which do not adhere to the metalline part, according to the Laws of Hydroſtatics are caſt upwards, and ſo the heavier metalline part is rendered purer. And thus in the metallurgic Art, the metalline Matter is often by fuſion ſeparated from the reſt. But in *No.* 2. by another metallurgic Operation, the metalline part of the Antimony is now freed from that ſulphureous one from which it could not be freed by ſimple fuſion, but which ſtill remained cloſely combin'd with it; and this is done by the help of the Powder of Tartar and Nitre, which is therefore called a *Pulvis Fuſorius.* And this we may conceive of in the following manner. When the Antimony, which conſiſts of a ſulphureous and metalline part (*Proceſ.* 208, 209.) is mixed with the Nitre and Tartar, and committed to the Fire, then the Nitre, Tartar, and Sulphur of the Antimony take fire with a prodigious *Impetus*, (*Proceſs* 130, 132), and by this means there is produced a fix'd Alcali from the Nitre and Tartar (*Proceſs* 130): But this fix'd Alcali, being agitated with this intenſe Fire, greedily attracts the Sulphur, and intimately unites it with itſelf (*Proceſs* 152), and then the metalline or mercurial part, as it is called, which is unaffected by an Alcali, being freed from its Sulphur, and put in fuſion, ſubſides from the lighter parts, and collects itſelf at the bottom into a Maſs, which goes by the name of *Regulus.* And as the long ſharp *Spicula* of the Antimony diſpoſe themſelves horizontally from the center to the ſurface, hence they form a Star, which the Alchemiſtical *Magi* call a *Stella Signata*, and have in great veneration. This *Regulus* now, tho' it appears pure, will upon being fuſed again with an Alcali, produce freſh *Scoriæ.* Nor perhaps can it be ever intirely freed from its Sulphur, and hence may be it always remains brittle, for Sulphur will render Metals ſo. The *Scoriæ* are the ſulphur of the Antimony, diſſolv'd in a fix'd Alcali (*Proceſs* 152); and hence their vertues are eaſily underſtood. The *Regulus* is emetic as the Glaſs is (*Proceſs* 210), and by infuſion yields an emetic Wine in the ſame manner. This then is another method of purifying Metals, by the help of Salts, from every thing ſulphureous, oily, and arſenical, which render the metalline Glebes brittle and volatile, and which being intirely ſeparated, the Metals become pure and fix'd.

PROCESS CCXII.

A Regulus *of Antimony with Iron and Nitre.*

APPARATUS.

TAKE of freſh Filings of Iron 8 ounces, make them red hot in a Crucible, and then gradually add of Antimony very finely powder'd, and made hot and dry 16 ounces. Keep theſe in a ſtrong Fire till they are thoroughly melted, and whilſt they are in this ſtate, throw in gradually of the pureſt, drieſt fine Powder of Nitre made very hot likewiſe, 4 ounces. Urge this mixture with the ſtrongeſt Fire till it flows like Water, and keep it in that condition for a quarter of an hour, and then, whilſt it is perfectly fluid, pour it into a melting Cone, exactly as in the preceding *Proceſs.* By this means I have had a ſtarry *Regulus* as bright as Silver, to the quantity of 7½ ounces. The *Scoriæ* are of a very different nature from the former, dry, hard, irony, ſulphureous, ſaline, and acrid, and ſcarcely diſſolve in the Air.

USE.

THE Sulphur of the diſſolved Antimony here greedily unites itſelf with the ignited iron (*Proceſs* 170), and hence produces ſulphureous *Scoriæ* of Iron.

Upon adding the Nitre, this is ſtrongly deflagrated with ſome portion of the ſame Sulphur (*Proceſs* 132, 133), and hence the whole is made to flow by the intenſneſs of the Fire. When the Matter then is in this very liquid ſtate, the metalline part of the Antimony, which is heavieſt, ſinks by its proper weight to the bottom, whilſt the Sulphur of the Antimony, the corroded Iron, and Nitre, are caſt to the top. *Paracelſus* aſſerted, that Iron would more intimately ſeparate the ſulphureous part of Antimony from the mercurial one, than could be effected by a vegetable Alcali; and hence that this *Regulus* was much the fitteſt to furniſh us with the Mercury of Antimony, for the profounder chemical Operations. And certainly we ſee by this Experiment, that Iron is capable of beautifully extracting the Sulphur from metalline Glebes, and giving them fixity and malleability. Hence *Alexander Suchtenius*, a Scholar of *Paracelſus*, has, upon this head, wrote two whole Treatiſes of Antimony, from which is borrowed the following *Proceſs*.

PROCESS CCXIII.

The Alchemiſtical Regulus *of Antimony.*

APPARATUS.

1. TAKE of Iron Nails 8 ounces, put them into a ſtrong, large, ſound Crucible, cover it with a Tile, place it in a wind Furnace, and cautiouſly raiſe a Fire till the Nails are perfectly ignited. Then by a little at a time, add of the beſt powder'd Antimony, made very dry and hot 16 ounces, and cover the Crucible a little with the Tile. As ſoon as ever the Antimony is thrown in, it emits a white Fume, and not a great while after is put into fuſion, and at the ſame time cauſes the Iron to melt likewiſe. When they are reduced to a very liquid ſtate, which may be examin'd by a long Tabacco-pipe, throw in gradually of the hotteſt, drieſt Powder of Nitre 3 ounces. Upon every injection then, there is excited a prodigious ebullition, noiſe, and conflict, and ſometimes a crackling; and if a Perſon ſhould unwarily throw in the Nitre damp, the whole would fly about with eminent danger to the Operator. When they have ſtood in this condition ſome time, the Matter caſts out lucid Sparks. Let it flow like Water for the ſpace of four or five minutes, and then pour it out into a melting Cone, which ſtrike gently, and when the Maſs is grown cold, knock it out. In this manner I have had 11 ounces 6 drachms of *Regulus*, and 11 ounces of *Scoriæ*, ſo that with what ſtuck to the Crucible whilſt it was pouring out, there were loſt 4 ounces 2 drachms.

2. Put this *Regulus* into another Crucible, ſet it in the Fire, melt it, and when it is in fuſion, add to it 3 ounces of Antimony reduced to Powder, and made very hot and dry, and when this is melted, throw in by degrees 3 ounces of Powder of Nitre, very hot and dry likewiſe, and then fuſe them with an intenſe Fire, and keep the Matter in a perfect liquid ſtate for the ſpace of five minutes, after which pour it into a melting Cone as before. By this means I have procured 10 ounces and 6 drachms of *Regulus*, which were purer than the former.

3. Take this ſecond *Regulus*, put it into a freſh Crucible, melt it again, and

throw into it 3 ounces more of Nitre with the ſame caution as before. Melt the Mixture with a very intenſe Fire, for otherwiſe it will not flow, and then pour it into a Cone. By this third fuſion I have had 9 ounces 2 drachms of an exceeding white ſilvery *Regulus*, that was ſurprizingly ſtarry, and 2 ounces 7 drachms of *Scoriæ*; ſo that there was loſt 1 ounce 5 drachms.

4. And once more melt this third *Regulus* in another Crucible, and then add 3 ounces of Nitre as before, which will then require a prodigious ſtrong Fire to melt it, tho' the *Regulus* flows at the bottom of the Crucible like Water. Keep them in perfect fuſion for the ſpace of an hour, and then pour them into a Cone. Thus then I have obtained 7 ounces 3 drachms of an exceeding pure and beautiful ſtarry *Regulus*, that look'd juſt like Silver, together with 2 ounces 7 drachms of *Scoriæ* of a golden Colour, and a perfect fiery Taſte; which is a pretty extraordinary *Phænomenon*.

5. For this Operation, the Crucibles muſt be very ſound, ſtrong, and large, and muſt be heated very gradually: The Fire muſt be equably kept up to its greateſt ſtrength, for otherwiſe the Nitre will not melt: And the Cones muſt be moderately warm, very clean, and perfectly dry, and within rubb'd over with Tallow. If you attend to theſe cautions, you will meet with ſucceſs.

USE.

THERE are many uſeful things to be learned from this Operation. Iron, which is vaſtly difficult of fuſion, melts in Antimony as all other Metals do in Lead, and then the Iron being corroded by the melted Antimony, becomes combined with its Sulphur, whilſt both the mercurial part of the Iron and the Antimony are expell'd, and uniting into one Maſs fall to the bottom, and the Sulphur of them both riſes together to the top. The Nitre that is thrown in burns furiouſly with theſe ſulphureous Bodies, agitates the melted Elements to their very inmoſt parts, and hence unites thoſe that are ſimilar, and ſeparates the heterogeneous. By the power of the Antimony the Iron is deſtroy'd, and its metallic Sulphur, which is the Gold of the Alchemiſts, unites with the internal metallic Sulphur of the Antimony, and thus both remain combined with the mercurial part of the Antimony, and hence you have a *Regulus*, which is beautified with a Star, and by its fine ſilver Colour teaches us the exceeding purity of its Mercury. The *Scoriæ* contain Iron, Sulphur of Antimony, and Nitre, united together, and chang'd into a wonderful Body, whoſe ſecret medicinal Vertues, when it is properly manag'd, and rightly apply'd, thoſe who are acquainted with theſe things greatly extoll. Theſe *Scoriæ* puff up ſurprizingly in the Air. But let this ſuffice concerning the firſt fuſion. In the ſecond, the external Sulphur is ſtill farther extracted, and the metalline Sulphurs of the Iron and Antimony are more fix'd with their Mercuries into a purer *Regulus*. In the third fuſion, the ſurprizing power of the ſulphureous metallic Fire that lies conceal'd in the *Regulus*, begins to diſcover itſelf, which by fixing the Nitre, renders it exceeding difficult of fuſion, tho' of all native Salts it was before melted with the gentleſt Fire, impreſſing upon it a remarkable igneous quality, ſo that upon being applied to the Tongue it truly burns it, tho' its proper Taſte is naturally exceeding cold, making it alcaleſcent, without the addition of any vegetable Subſtance, and cauſing it to run ſpontaneouſly in the Air, tho' it would remain dry in it before. The fourth fuſion diſcovers the ſame things more evidently:

dently: Here the pure Sulphur, only by its odorous exhalation, as it were, and ſimple contact, changes the Nitre more powerfully, and thus demonſtrates the ſecret power of metallic Sulphurs. This *Regulus* has almoſt turn'd the Heads of ſome of the profoundeſt Chemiſts. Conſult *Paracelſus*, *Suchtenius*, *Philaletha*, *Pantaleon*, *Becher*, and *Stahl*. And for my own part, when I reflect upon the Time and Pains I have employed in the examining into the nature of this *Regulus*, I can't help being ſurprized at my own Patience, and can hardly help bluſhing, to think, that ſo great a part of my Life ſhould have been ſpent in this Inquiry; but *trahit ſua quemque voluptas.* The Colour of Gold, now, as in the ſame manner exalted, or reſtored by means of this *Regulus*, as the exceeding white Nitre, by being thrown into this *Regulus* in fuſion, is immediately diſtinguiſhed by a golden one. The *Regulus*, depurated even in this manner, will vomit. The *Scoriæ* give a beautiful Tincture to Alcohol.

PROCESS CCXIV.

Golden Sulphur of Antimony.

APPARATUS.

BOIL the *Scoriæ* of *Proceſs* 212*, till they are all diſſolved. Into the inodorous Liquor drop Vinegar, and there will inſtantly ariſe a moſt noiſome, ſtercoraceous Stink, and the Liquor, which before was thin, will become very thick. Drop in more Vinegar, ſtir the Mixture about, and proceed in this manner, till nothing more will precipitate. Let the Veſſel ſtand quiet, and there will a Matter gradually ſubſide to the bottom, which will be reduced to a much leſs compaſs than one would expect. Pour off the Liquor that ſwims at top, waſh the Precipitate with Water till it is abſolutely inſipid, dry it gently, and keep it under the title of *Auratum Sulphur Antimonii.*

USE.

THE *Scoriæ* of *Proceſs* 212* conſiſt of Sulphur of Antimony, and an Alcali: Theſe boil'd in various Waters make a ſulphureous *Lixivium*; and from this, by the Acid, is precipitated the Sulphur. This has an emetic quality, but a milder one. If this is rubbed upon Silver, it makes it of the Colour of Gold, and hence it is called *Auratum.*

PROCESS CCXV.

Crocus *of Antimony.*

APPARATUS.

TAKE of Antimony and Nitre equal parts, and reduce them to a very fine Powder. Set an Iron Ladle on the Fire, and make it almoſt red hot, and throw into it a little of this Powder, which will take Fire like Gun-powder. When all is grown quiet, throw in a little more, which will go off like the former,

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* Should not this be 211?

mer, and ſo proceed till the whole Mixture is deflagrated. You will then have a Matter of a brown yellowiſh Colour, the bottom of which will ſomewhat reſemble Glaſs, upon which there will be ſome lighter *Scoriæ*. Reduce the whole to a fine Powder, and then waſh it with hot Water, till the *Calx*, of the Colour juſt mentioned, remains inſipid. The Waters this is waſhed with being filtered, are pellucid, but, upon dropping a little Vinegar into them, become of an Orange Colour, and let fall a fine Powder, very much like that of the preceding *Proceſs*, but more ſubtil.

USE.

THE Sulphur, Nitre, and black Antimony make a ſort of Gun-powder; which therefore goes off in the ſame manner. The metalline part is by this means calcined into Glaſs and *Scoriæ*, both which are violently emetic, and being infuſed in Wine will give that the ſame quality. The change of the Colour is here remarkable. If this Operation is performed in a large Crucible, with an intenſe Fire, and a large quantity of Ingredients, and the Matter is then made to flow, you will have an extemporaneous Glaſs at the bottom, which being ſeparated from the *Scoriæ*, has the ſame medicinal effects with the laborious Preparation of *Proceſs* 210.

PROCESS CCXVI.

A milder Emetic of Antimony.

APPARATUS.

MIX 1 part of Powder of Antimony with 2 of Nitre, and throw them a little at a time into a red hot Crucible, and you will have the ſame detonation as in *Proceſs* 215, but the Matter will be white, which being thoroughly waſhed, gives you a white inſipid *Calx* of Antimony. If the Water that it is waſhed with is filtered, you'll find it ſalt.

USE.

THE proportion of the Nitre here being increaſed produces another Colour, though the deflagration happens in the ſame manner. This *Calx* is much milder than the preceding, often exciting *Nauſea's* only, and ſlight Vomitings, with a diſcharge of a good deal of *Saliva*, and a thick Urine from the ſtimulated *Viſcera*. The *Lixivium* of this, upon dropping in of Vinegar, precipitates a white *Calx* nearly of the ſame Vertues.

PROCESS CCXVII.

A diaphoretic nitrated Antimony.

APPARATUS.

TAKE of Antimony 1 part, of Nitre 3 parts, reduce them to Powder, throw a little of the Mixture into a red hot Crucible, and it will deflagrate as before. Proceed in this manner till you have uſed all your Powder, taking a great deal of care not to throw in any of it till the preceding Portion is perfectly deflagrated. Keep the Matter in the Fire for the ſpace of a quarter of an hour, the Crucible all the time being perfectly red hot, and then let it cool, and you will find in it a hard, white Maſs. Take this out, powder it, and keep it under the Title *AntimoniumDiaphoreticum Nitratum.*

USE.

IF you take $\frac{1}{2}$ a drachm of this Medicine well prepared, it produces ſcarce any ſenſible alteration, except that on account of the fixing Nitre that adheres to it, it moderately opens, and hence in acute Diſtempers does ſome ſervice. Then the Chemiſts call it a Diaphoretic, and think that the arſenical Poiſon of the Antimony is fix'd by means of the greater quantity of Nitre. But in the Antimony there was at firſt nothing emetic, tho' you took it without any preparation, or the addition of any Nitre; and yet an equal quantity of Nitre gave it an emetic quality: As we may conclude ſafely therefore from Experiments, let us not give too much into *hypotheſes.* Let the Followers of *Baſil Valentine* here learn, that there is no need of ſo much caution to free this diaphoretic Antimony nicely from its fixing Nitre; for it neither produces anxieties, *nauſea's*, or vomiting, but ſtimulates kindly and ſafely. There is more to be feared from the waſh'd *Calx.*

PROCESS CCXVIII.

The common Diaphoretic Antimony, called Sweet Antimony.

APPARATUS.

TAKE the calcined Antimony of *Proceſs* 217, reduce it to a fine Powder, pour hot Water upon it, and ſtir them about with a Stick, by which means, the fixing Nitre that adheres to it, will be diſſolv'd. Let the white *Calx* ſubſide, pour off the ſaline Liquor at top, put on more Water, and thus render the *Calx* perfectly ſweet, ſo that there ſhall be no Nitre ſenſibly adhering to it, and then dry it, and it will be white, inſipid, and heavy, and is the thing you want.

USE.

THIS is called diaphoretic, for the reaſon given in the preceding *Proceſs.* But it is an inert, noxious *Calx*, without any thing active in it, as far as one can judge by its effects, and wants every thing valuable that it had before. It acts only in a ſenſible manner when it is mix'd with half as much of a purgative, for then it truly quickens its Operation, as appears by undoubted Experiments in the *Pulvis Cornachini.* But otherwiſe I diſſuade the uſe of it. How wonderfully now are the Colours chang'd in the Antimony, by ſimply varying the proportion of the Nitre in the Calcination? And what a ſurprizing alteration do we find in the Strength?

PROCESS CCXIX.

Nitrated Antimony.

APPARATUS.

TAKE the Waters with which the preceding *Calx* was waſhed, filter them, put the *Lixivium* into a clean Urinal, and exhale to a dryneſs, keeping it conſtantly ſtirring to the end. By this means then you will have a white ſaline Matter, of a ſingular, and not diſagreeable Taſte, not like that of Nitre, but ſofter, which keep under the Title of *Nitrum Stibiatum.*

USE.

HENCE we learn, that Nitre by detonation with Antimony, is converted into a new Salt. This Salt is kindly aperient, and in a phlogiſtic diſpoſition of the Blood, beautifully diſſolves the inflammatory denſity without violence, and happily diſpoſes to Perſpiration, gentle Sweats, and a diſcharge by Urine, and hence cools, and proves of ſervice in the Small Pox, Meaſles, Pluriſy, and Peripneumony. How unreaſonably therefore is this Water thrown away, as being of a hurtful nature!

PROCESS CCXX.

Fix'd Sulphur of Antimony.

APPARATUS.

INTO the nitrous Liquor of *Proceſs* 218, put into this Urinal, and now hot, and very pellucid, I here drop ſome very ſtrong diſtilled Vinegar, and you ſee it inſtantly grows milky, and precipitates an exceeding white, and very fine Powder. I ſhake them together, and proceed to drop in more, ſhake them again, and repeat this till the Liquor will not be affected by the Vinegar any longer. Let the Veſſel then ſtand quiet till all the Powder is ſubſided to the bottom, pour off the Liquor into a clean Veſſel, waſh the Powder with Water till it is perfectly inſipid, and then dry it, and you will have a very white, inſipid, fine Powder, which is called *Sulphur fixum Antimonii.*

USE.

IN the deflagration of the Antimony with the Nitre, the Sulphur of the former unites with the latter, as in *Proceſs* 215. And the Sulphur thus reſolv'd and combin'd with the Nitre, is diſſolv'd with it in Water; but as ſoon as ever an Acid comes to it, it precipitates from the Nitre, as we ſee here upon the inſtillation of Vinegar, and at the ſame time the Acid unites with the Nitre without any ſign of an Efferveſcence. The Powder then that falls to the bottom being waſh'd, is true Sulphur of Antimony. *Tachenius* extolls this Powder taken in Vinegar, as the moſt powerful anti-peſtilential Medicine. But for my part, I confeſs, I think it ought to be look'd upon as an abſolutely inert *Calx,* noxious on account of its weight and indiſſolubility, or at leaſt doing no manner of good: The Vinegar, however, taken along with it, I acknowledge to be particularly ſerviceable in the caſe mentioned. In this manner are the Chemiſts too apt to cry up the Preparations of their Art, particularly thoſe from Antimony, and then eſpecially when they don't produce any ſenſible effects. But that acetoſe, nitrous Liquor, now, that ſwims at top of the precipitated Powder, has the moſt efficacious Vertues in acute febrile Diſorders, both on account of the Vinegar, and the ſoft Nitre which is now freed from the inactive Sulphur. Thus in the Chemical Art, is the beſt part frequently thrown away. From all theſe inſtances then, Gentlemen, you perceive, how ſurprizingly Sulphur is diſſolv'd, lies conceal'd, and is reſuſcitated in various Forms, and various Colours.

PROCESS CCXXI.

The diſtillation of Antimony into an icy Butter, and Cinnabar.

APPARATUS.

TAKE of corroſive ſublimate of Mercury 2 pounds, rub it in a warm dry glaſs Mortar with a glaſs Peſtil, till it is reduced to a very fine Powder. Then take of the beſt Antimony 1 pound, which ſeparately likewiſe powder very fine. Mix theſe as nicely as poſſible in a glaſs Mortar, and they will grow warm, and emit a Fume, of which beware with the utmoſt caution. Have by you at the ſame time a clean, dry, glaſs Retort, that will hold three or four times as much as your Powder, which ſhould have a large Neck, and be cut off ſo low that the Mouth may be very wide. Dry the Powder very well, and then put it into the Retort made hot and dry likewiſe, taking care that nothing black hangs about the inſide of the Neck. Place the Retort thus charg'd in a ſand Furnace, ſo contriv'd for this purpoſe, that the Belly of the Retort may almoſt touch the bottom of the Pot, and yet its Neck may lie in a declining poſition. This being done, apply a large Receiver ſo cut that the Mouth of it may exactly admit the Neck of the Retort, and cover the Retort with Sand. Let the whole *Apparatus* ſtand under a Chimney that will carry up the Fumes without diſperſing them, make a little Fire, and when the Retort is grown moderately hot, with a Paſte made of Clay and Lime lute the Joint. Then raiſe your Fire very gradually, and in the firſt place the Receiver will begin to be clouded, and there will be a ſmall quantity of a Liquor collected in it: Carefully keep up your Fire in this degree, till nothing more of this Liquid will come off. When this ceaſes, increaſe your Fire, but very cautiouſly, till you perceive a pinguious Matter riſe into the Neck of the Retort, and diſtill into the Receiver, coagulating whilſt it paſſes from one to t'other: Keep up this Fire to the ſame height, and there will be a white icy Matter concreted, and remain in the Neck of the Retort. On both ſides of it, therefore, lay ſome live Coals firſt at a diſtance, and afterwards nearer and nearer, till the Neck of the Retort is grown as hot as the Belly of it, and then the Matter will melt and drop into the Receiver. Proceed with this degree, and then very gently increaſe it till no more Butter riſes into the Neck, and all that has riſen, is diſtill'd into the Receiver. Then remove the Receiver, taking all poſſible care that none of the Vapour comes to your Lungs, and preſently ſtopping it ſet it by. Lute on another properly fitted for this purpoſe, and increaſe your Fire, and you will have a Matter come off, of a yellow, red, blackiſh, and various other Colours, upon which raiſe your Fire to the higheſt degree, and at laſt place Fire upon the Sand at top of the Retort, that the Sand may be almoſt red hot, and ſo leave them for the ſpace of two hours. Let the whole ſpontaneouſly cool, and then remove the Receiver, in which you will have ſome quantity of crude Mercury, and a Butter rendered impure by the ſulphureous Fumes of the Sulphur of the Antimony. In the Neck of the Retort too you will find a Matter of various Colours made up of the Mercury, Sulphur, and Butter; and upon breaking the Retort, there will be ſome antimonial *Fæces* at bottom. But at the beginning of the Neck, you will find a denſe, hard, opake, and very heavy Maſs, the ſurface of which that is contiguous with the Glaſs, will have a ſhining appearance, whilſt the other is rough, and which being reduced to Powder, is true Cinnabar of Antimony, and is ſufficiently coſtly. In this *Proceſs* there is need of a great deal of patience, for if the Fumes ſhould inſinuate themſelves through the cracked Glaſs, or Lute, or any other way, and be received into the Lungs, by their cauſtic quality they would prove fatal.

USE.

AS the nature of Antimony and ſublimate of Mercury has appeared from what has been already laid down, the chemical *Ratio* of this *Proceſs* is eaſily underſtood. Whilſt the Fire acts upon the Sublimate, the *Aqua Regia* that is in it, unites itſelf with the mercurial, metallic, reguline part of the Antimony, and thus leaving the Mercury, with which it was combined before, that returns to its original form, and runs at the bottom of the Retort. Hence the *Regulus* is ſublimed with the Spirit of Salt, and becomes a volatile Vitriol of Antimony, call'd a Butter, conſiſting of an exceeding pure *Regulus*, and Spirit of Sea-Salt combined together. When theſe now are ſeparated, and ſublimed, then the Sulphur of the Antimony diſcharged from the reguline part, and the crude Mercury freed from its Acid, remain at the bottom of the Retort, and by the action of the Fire become united together, and ſublime into Cinnabar. This Butter of Antimony is the moſt ſpeedy cauſtic we know of, producing an Eſchar the ſooneſt of any thing, which ſeparates in a very ſhort time, for the moſt part the ſame day it is made. It eaſily melts with the moiſture of the Air, and then it loſes its pellucidity, grows white, and precipitates a very white Powder. It diſſolves with Heat too, but in the Cold returns again to its icy form. The variety of Colours in this *Proceſs*, ariſes from the Sulphur of the Antimony. If inſtead of crude Antimony you take the very pure *Regulus* of *Proceſs* 213, and proceed exactly in the ſame manner, you obtain only a Butter, and a Mercury, both exceeding pure, becauſe then there is no Sulphur, and the Acid being intirely received into the *Regulus*, the Mercury returns in its greateſt purity. Here then, Gentlemen, you ſee what a ſingular effect the Spirit of Salt, which adhered to the Sublimate, has, whilſt it ſublimes the fix'd *Regulus* of Antimony in a Sand Heat. But it has the very ſame upon all metalline Bodies, Gold itſelf not excepted. How wonderful a Body then is Sea-Salt? The Chemiſt certainly can never too much employ his Art upon it, as he will always diſcover ſomewhat that will make him amends for his trouble.

PROCESS CCXXII.

The Diſtillation of Butter of Antimony into a liquid Oil.

APPARATUS.

TAKE the Butter of Antimony of the preceding *Proceſs* broke to pieces with ſome glaſs inſtrument, the Neck of a Bolthead, for Inſtance, and put it into a clean glaſs Retort, taking care that it don't diſſolve in the Air, nor offend you with its Vapour. With a gentle Fire, gradually increaſed, draw it off into a dry clean Receiver, raiſing it till all the Butter is come over, which at laſt will require a Heat conſiderably intenſe, and you will have it nearly in form of a liquid Oil of Antimony. If you diſtill this Oil a third time, it will ſtill become more limpid, and if it is rightly ſecured in a cloſe Veſſel, will continue in this Condition. Will this, which is a pretty ſurprizing Experiment, illuſtrate ſome obſcure places in *Paracelſus?*

USE.

THIS beautiful Experiment gives us a great inſight into the method of rendering Metals volatile, and converting them into the true form of a liquid Oil; and diſcovers to us the wonderful Power of Sea-Salt in giving Volatility to Metals, and its ſurprizing quality, whilſt it remains united with Antimony, for it ſo long is extremely poiſonous, ſending forth a truly arſenical Vapour, and yet when it is ſeparated from the Antimony again, it becomes quite harmleſs. Is there not ſome room therefore to ſuſpect, that there lies hid here ſomething of an alcaheſtical Vertue? Certainly it renders all Metals diſtillable in a Retort, without any Alteration in their Weight, and is recover'd from them again almoſt in its full power. This, if you think proper, you may inquire into. This Oil is vaſtly cauſtic, and ſupplies ſkilful Surgeons with the moſt ſpeedy Eſcharotic. This *Proceſs* has been ranked amongſt the profoundeſt *Arcana.* If you have a mind therefore to try it yourſelves, whatever you do, be ſure take care of the Fumes: I knew a very worthy and famous Man to whom they proved fatal. Again therefore let me caution you to beware of them.

PROCESS CCXXIII.

Mercurius Vitæ *of Antimony, and its* Regulus.

APPARATUS.

IN this clean clear Glaſs I have ſome pure Water, into which I let fall one drop of the Oil of Antimony of the preceding *Proceſs*, melted and depurated. You obſerve then the very inſtant it comes to the Water, from pellucid it becomes white, and falls to the bottom. I have now in this manner dropp'd in one fourth part of Oil, with reſpect to the Water, and it is all converted, as you ſee, into an exceeding heavy white Powder, which is collected at the bottom. I ſtir them well together with a glaſs Rod, ſo as to mix them as thoroughly as poſſible, and when they have ſtood quiet for ſome time, there is a very limpid acid Liquor ſwimming at top, which I gently pour off. Upon the Powder then I put more Water, and when by this means I have waſhed it till it is perfectly inſipid, I dry it with a gentle Fire, and have then a white, inſipid, heavy Powder.

USE.

THUS then we ſee that the Acid of Sea-Salt adheres to the Antimony ſo long only as it continues exceeding ſtrong, receding from it as ſoon as ever it comes to be lowered with the leaſt quantity of Water, and then being attracted into the Water. This Powder given to 2 or 3 grains is a violent emetic, and from the fatal effects it has ſometimes had, has been called *Mercurius Mortis.* If it is laid upon Glaſs, and expoſed for a good while to a gentle Fire, being kept conſtantly ſtirring all the time, it loſes its ſtrength, and becomes leſs active, and then is thought by many Perſons to be the *Arcanum* of *Riverius*. This Powder contains nothing of Mercury in it, whatever honeſt *Billichius* ſays to the contrary in his *Paradoxæ Chemiatricæ*, but the pureſt *Regulus* of Antimony. I took 11 ounces of this *Mercurius Vitæ* prepared with my own Hands, and putting it in a ſtrong large Crucible, placed it in a Wind Furnace; and by this means the Powder was melted as ſoon as ever the Crucible came to be thoroughly red hot. When it was perfectly in fuſion I poured it out into a melting Cone, and had 10 ounces of a ſhining *Regulus*, but a little upon the greyiſh, conſiſting of *Spicula* ſurprizingly diſpoſed among one another.

PROCESS CCXXIV.

Philoſophic Spirit of Vitriol.

APPARATUS.

TAKE the limpid acid Liquor of the preceding *Proceſs*, filter it, and inſpiſſate it to one half, and you will have the *Spiritus Vitrioli Philoſophicus.*

USE.

THIS very limpid, and gratefully acid Liquor has the Taſte of Spirit of Sea-Salt, and has the very ſame Effect in every chemical and medicinal Operation. Nor is there any thing in the leaſt emetic in it, but it is an exceeding pure Spirit of Sea-Salt, which, through all the Operations it has undergone, with the Sublimate of Mercury, the Antimony, its Butter, Oil, and the Water, has ſtill retained its proper nature, nor is ſo much as tainted by any admixture, but has an admirable ſalutary Acidity. It is improperly therefore called a vitriolic Liquor, for it contains nothing at all of Vitriol, but with the alcaline Salt of Tartar, returns to Sea-Salt. As I am greatly fond now of Sea-Salt, on account of its ſurprizing Effects in chemical Operations, I had a mind to examine into the nature of this production of it. To this purpoſe I took a large quantity of this Liquor, and diſtill'd it in a tall, clean, glaſs Cucurbit, and the Liquor came off exceeding pure, nor left any thing at all at the bottom. Hence therefore I learned, that the Water, by ſimple affuſion, in an inſtant extracted the Spirit of the Salt in ſuch a Manner from the Butter of Antimony, that nothing at all of the Antimony remained united with it, though it before roſe out of the Retort combin'd with the *Regulus* in form of a Butter. I then diſtilled all the Liquor again in a tall Cucurbit, and afterwards once more with a gentle Fire of 100 degrees, and there then came off a pure Water, which had not the leaſt Taſte of an Acid: This degree of Heat I kept up till nothing more would riſe. The remaining Liquor I urged with a Fire a very little ſtronger, ſo that there roſe a Liquor that was ſomewhat acidiſh, which I carefully ſeparated likewiſe with the ſame degree, and kept under the Title of an acidiſh Phlegm of Philoſophic Spirit of Vitriol: This is of conſiderable ſervice, where acidiſh Medicines are wanted. The Liquor then that was left I diſtill'd with a Cucurbit, and I found it a very acid, limpid, pinguious Spirit of Sea-Salt that fum'd a little. Thus then I learned the wonderful nature of this Salt, its eaſy combination, and eaſy ſeparation.

PROCESS CCXXV.

Van Helmont's *Flowers of Antimony.*

APPARATUS.

1. TAKE of Antimony, diſſolved in *Aqua Regia* according to *Proceſs* 208, 1 pound, put it into a low, open, glaſs Veſſel, and expoſe it for a good while to a gentle Fire, keeping it continually ſtirring with a glaſs Rod till the Matter is become very dry. Then in a glaſs Mortar, and with a glaſs Peſtil, reduce it to a very fine Powder, to which add as much of the drieſt *Sal Ammoniac*, as there is of the *Calx*, and then rub them together, the longer the better, that they may be mixed as intimately as poſſible. Put this Mixture into a low glaſs Cucurbit with a wide Mouth, fit on a very large, clean Alembic, and lute the Joint with a Lute made of Linſeed-flower. Place the Cucurbit in a Sand Furnace in ſuch a manner as to ſtand a little leaning forwards, that the Water in the Sublimation may eaſily paſs out of the Alembic into the Receiver. Then cover the Cucurbit with Sand up to the rim of the Alembic, raiſe a gentle Fire, and there will come off a limpid, acid Water, which by increaſing your Fire a little will be all expell'd. Gently raiſe your Fire, and ſomewhat white will begin to riſe, upon which keep it up to ſuch a degree, that you can juſt bear your Hand upon the Head, and then the Alembic will be filled with all kinds of Colours. Continue the Fire in this degree for the ſpace of eight hours, and you'll be greatly entertained with the beautifulneſs of the appearance. Let the whole cool, very gently take out the Cucurbit, clean both this and the Alembic from the external dirt, and then carefully remove the Head, taking care of the firſt Vapour, and you will find almoſt all the Antimony ſublimed with the *Sal-Ammoniac* into a variegated Matter. Take this out preſently, and put it up into a dry, hot, glaſs Veſſel, under the Title of *Helmont*'s *ſalt Flowers of Antimony*. Theſe, if they are taken in the ſmalleſt quantity, are a very powerful Emetic. At the bottom you will find ſomething that may be ſublimed with freſh *Sal-Ammoniac*.

2. Put theſe Flowers into Water, and ſtir them well about, and the Water will grow milky. Let it ſtand quiet, and ſettle, and at top there will ſwim a

ſaline, ammoniacal Liquor, which pour off. Waſh the Flowers in this manner till they are quite inſipid, and then dry them with a gentle Heat, and you will have a very fine, red, inſipid Powder, which is greatly emetic. Theſe are called *Van Helmont*'s ſweet emetic Flowers of Antimony. If the *Lixiviums* theſe are waſh'd with are inſpiſſated, you have a *Sal-Ammoniac* fit for the ſame uſe again.

USE.

HERE then you have an inſtance of the manner in which *Paracelſus* thought a chemical Death and Reſuſcitation, as he expreſs'd himſelf, opened Metals, and by this means made them exert themſelves efficaciouſly in the human Body. Here we ſee a fixed Body become volatile, and here we obſerve the production of all ſorts of Colours. Thus the black Powder of Antimony, or Head of a Crow, being reduced to a white *Calx*, becomes the Neck of a Swan, and afterwards acquiring a great variety of beautiful Colours, is chang'd to the Tail of a Peacock: But it is emetic under all theſe alterations.

PROCESS CCXXVI.

Van Helmont's *fix'd diaphoretic Flowers of Antimony.*

APPARATUS.

TAKE of the ſweet Flowers of the preceding *Proceſs* 1 part, of the pureſt drieſt Nitre 3 parts, and rub them well for a good while in a glaſs Mortar. At the ſame time have a clean Crucible ſtanding in the Fire red hot, into which throw a little of this Powder, firſt heated, and it will deflagrate, but very weakly. When every thing is quiet, throw in a little more, and ſo proceed till you have made uſe of all your Powder. When the Matter then in the Crucible is grown cold, it will be of a white Colour, inclining to yellow. Take this out carefully, pound it, waſh it with Water, and dry it, and you will have a fine white Powder. Put this into a *China* Diſh, pour Alcohol upon it, ſet it on fire, and whilſt it is burning keep the Powder continually ſtirring about with a Tabacco-pipe. When the Alcohol then is burnt out, there will remain *Van Helmont*'s Diaphoretic, 36 grains of which is ſaid by promoting Sweat to cure all intermittent and continued Fevers.

USE.

HERE we have an inſtance of fixing a volatile Body, for chemical uſes. This Diaphoretic, its Author greatly extolls. I have made it myſelf, however, and tried it frequently, but I could never find any ſuch extraordinary Vertues in it, as he mentions in his *Aurora Medicinæ*, written in *Dutch*; and hence I am apt to believe, that in other Caſes likewiſe he has indulged himſelf a little too much in crying up his own Preparations.

PROCESS CCXXVII.

The Purgans Diaceltateſſon *of* Van Helmont *with fixed Flowers of Antimony.*

APPARATUS.

TAKE of the fixed diaphoretic Antimony of the preceding *Proceſs* 18 grains, of Reſin of Scammony 16 grains, of Cream of Tartar 7 grains, mix them, and reduce them to a fine Powder. Or take of the fixed diaphoretic Antimony

9 grains, of Reſin of Scammony 9 grains, of Cream of Tartar 3 grains, and make them into a Powder. This is the deſcription of the Purge given us by *Helmont*, which *Paracelſus* called the *Diaceltateſſon:* The firſt is the greateſt, the laſt the leaſt Doſe for an Adult. It muſt be taken without any acid, and may be ſtopp'd by an Acid, if it operates too violently. It muſt be given in Intermittents in ſuch a manner that it may finiſh its Operation as nearly as poſſible by the time the Fit is expected. The Author ſays it always cures Quartans before the fourth Doſe, and proves efficacious in all Intermittent and continued Fevers. *Auror. Medicin.* publiſh'd in *Dutch*, p. 187, 188, 288.

USE.

HERE we have another chemical *Arcanum*, under the name of a purging *Diaceltateſſon*, as you may find in the *Dutch* Edition juſt cited. Concerning this *Van Helmont* ſays, that it radically cures the Gout and Fevers, that it heals Ulcers of the *Larynx*, Bladder, and *Æſophagus*, and that it purges the Body only ſo long as it is not ſound, and no longer. See the *Latin* Edition, p. 775, 776, where he ſays the Doſe is 8 grains, ſo that the account in the *Dutch* Edition does not agree with this. But I am always ready to ſuſpect, that this great Man, by a ſubtlety of reaſoning, extended the Vertues of theſe *Arcana* farther than could be fairly warranted by Experiment. Theſe things I have prepared myſelf, and upon making uſe of them have ſeen very good Effects from them, but not ſuch ſuperlative ones as he inſinuates.

Here then, Gentlemen, you will give me leave to put an end to our chemical *Proceſſes*, as I have now, according to my promiſe, exhibited all thoſe to you that are neceſſary to the underſtanding all the reſt. A few things however I think I ſhould here ſubjoin concerning ſome Operations, that are very uſeful both in Natural Philoſophy and Medicine, and which from a conſideration of the preceding *Proceſſes* may be eaſily underſtood. And of theſe let the firſt be,

A Chemical SOLUTION.

AND this is performed,

1. With Water, by Dilution, Infuſion, Decoction, Diſtillation, Mixture, Fermentation, Putrefaction, and Separation.

2. With Oil, by Dilution, Infuſion, Decoction, Diſtillation, Mixture, Separation; not ſo much by Fermentation, or Putrefaction.

3. With Fire, by Calcination, Uſtulation, Uſtion, Fuſion, Sublimation, Mixture, and Separation, and by its aſſiſting the actions of other Bodies.

4. With Air, by Fermentation, Putrefaction, Agitation, and the addition of other Particles that have a diſſolving power, and excitation of thoſe that are already preſent.

5. With fermented Spirits, by Dilution, Infuſion, Decoction, Diſtillation, Mixture, and the rendering the Oils more liquid.

6. With alcalious Salts, by Calcination, Uſtulation, Uſtion, Fuſion, Mixture, and Separation, according to the various degrees of the dry Fire made uſe of.

7. With volatile alcaline Salts, in a dry way, by Sublimation; in a wet one, by Dilution, Digeſtion, and Diſtillation.

8. With fixed alcaline Salts, put in motion by the aſſiſtance of Water, and Fire, by Digeſtion, Decoction, Dilution, Separation, and Mixture.

9. With the fixed acid Salts of Alum, Sulphur, and Vitriol, either ſeparated in

form of a Liquid, or lying concealed within their *Calx's*, by Dilution, Decoction, Diſtillation, and Digeſtion, or in a dry form by Calcination, Uſtulation, Uſtion, and Diſtillation.

10. With the more volatile Acids, by Dilution, Digeſtion, Diſtillation, and Penetration.

11. With compound Salts and Soaps, by Calcination, Sublimation, Diſtillation, and Digeſtion, either in a dry form, or a liquid one.

12. With Metals, by Fuſion, or *Amalgama's.*

A Chemical COAGULATION,

IS effected,

1. With Water, by Congelation, Chryſtallization, and Precipitation, as in *Mercurius Vitæ.*

2. With Oil, by uniting Sulphur, Salts, and Metals with itſelf, by the aſſiſtance of Fire.

3. With Alcohol, upon a volatile alcaline Spirit, Whites of Eggs, *Serum* of Blood, and Oil of Vitriol.

4. With an Alcali and Acid, uniting in a ſolid form, as particularly in vitriolated Tartar.

5. With a fixed alcaline Salt, as in Milk.

6. With an acid Salt, as in Milk, *Serum*, and Whites of Eggs.

A Chemical PRECIPITATION,

IS the Separation of a diſſolved Body from its Solvent by the addition of ſomething new, in ſuch a manner as to render it manifeſt to the Senſes, though before it lay concealed. And this is of very great uſe, and therefore deſerves to be nicely conſidered, and indeed has been every where taken notice of in the preceding *Proceſſes.* This now is brought about,

1. By pouring Water upon Oils diſſolved in Alcohol, which have then a milky appearance.

2. By pouring Water upon reſinous Bodies diſſolved in Alcohol, with a milky appearance likewiſe.

3. By Water, in the Diſtillation of oily Spirits, if in the end any Water comes off after the oily Spirits.

4. By Acids with Acids: Thus Silver diſſolv'd in Spirit of Nitre, is precipitated by Spirit of Salt; as Mercury is likewiſe.

5. By Metals with Metals and other Bodies. Into this Glaſs, which contains an ounce of Silver diſſolved in Spirit of Nitre, and then diluted with twelve times as much Rain-water, I immerge ſome poliſhed Plates of Copper, and the Silver is precipitated immediately, and the Copper diſſolved. In this Glaſs now I have the Copper diſſolved in the Spirit of Nitre, out of which the Silver was precipitated, into which I put ſome pure Plates of Iron, and the Copper preſently precipitates, the Iron is covered over with a pappy Matter of a Copper Colour, the Copper falls to the bottom, and the Iron is diſſolved. And again, in this Glaſs I have the Iron diſſolved in the Spirit of Nitre, from which the Copper was precipitated, and I now drop into it ſome Oil of Tartar *per Deliquium*, upon which the diſſolv'd Iron is precipitated, and the Alcali uniting with the Acid produces a true Nitre again after ſo many alterations. Thus the Spirit paſſes out of one Body into another, ſcarcely becoming either better or worſe, though it is attracted more by one

thing than another, till at laſt it reſts in that which in this reſpect is ſtrongeſt, nor will be expell'd thence except by ſomething more powerful, as if upon this regenerated Nitre you ſhould pour Oil of Vitriol. Upon theſe two Principles depend the Doctrine of Precipitations, which is the true, though often abſtruſe cauſe of an infinite number of Operations, both in Art and Nature. I take a grain of white or red Precipitate of Mercury, and rub it upon the ſurface of a poliſhed Copper Plate made hot, and it preſently acquires a Silver Colour: Here the Copper attracts the Acid of the Nitre out of the mercurial *Calx*, and thus produces an *Amalgama* upon its ſurface, which then looks like Silver.

6. Alcali's often precipitate Bodies diſſolved in Acids: This happens frequently, but not always, and ſometimes only in part. In Copper diſſolved in an Acid an Alcali cauſes a Precipitation, but then the Salt, ariſing from theſe Oppoſites, afterwards cauſes a Solution.

7. Acids for the moſt part precipitate Bodies diſſolved in Alcali's; but here too, as in the preceding caſe, there are ſome exceptions.

8. The moſt acrid Salts, when they lie intirely concealed in Bodies, but without any alteration, by means of the Precipitations they bring about, produce the moſt ſurprizing effects, which could not poſſibly have been foreſeen by the help of any Art whatever. If an ounce of the moſt inodorous, inſipid, inactive *Luna Cornea*, that don't in the Fire diſcover the leaſt ſign of Acrimony, is rubb'd, or with a melting Fire in a glaſs Retort is combin'd with half an ounce of inodorous, inſipid *Regulus* of Antimony, there is produced in an inſtant the moſt virulent, cauſtic Butter of Antimony, the very Vapour of which is a fatal Poiſon. How dangerous therefore is the mixing Bodies together, and of conſequence, what caution ſhould be uſed on theſe occaſions?

A Chemical EFFERVESCENCE

1. IS a ſudden agitation ariſing in Bodies upon mixing them together, tho' whilſt they were ſeparate, they were intirely at reſt. And this happens in a different manner, betwixt different Bodies. A ſhort account of this therefore we ſhall now lay before you, but ſuch a one as may be ſufficient for your underſtanding what is omitted. The principal Bodies then in which this phyſical action is obſerv'd, are

1. Native vegetable Acids, as the Juices of moſt Trees, Shrubs, and Plants, when they are in their more liquid ſtate in the ſpring Seaſon; the Juices of moſt ſummer Fruits before they are ripe; ſome particular Juices that retain an Acidity even when they are ripe, as thoſe of Oranges, Citrons, Lemons, Tamarinds, garden and wood Sorrel, and acid Apples. Fermented vegetable Acids, as aceſcent Meals, *Rheniſh* and *Moſelle* Wines and Tartar. Doubly fermented vegetable Acids, as native and diſtill'd Vinegars. Animal Acids, from aceſcent, or acid vegetable Food, contain'd in their Chyle, Milk when it is ſour, Skim-Milk, Butter-Milk, and its Whey. Native foſſil Acids, as the vague Acid of Sulphur, Alum, or Vitriol in the Mines, either lying conceal'd in their proper Bodies, *viz.* Sulphur, or vitriolic Glebes, or extracted from them by an intenſe Fire, or diſlodged by a ſuperior Acid, as Spirit of Nitre, Salt, Alum, Vitriol, and Sulphur.
2. True fix'd Alcali's produced from any vegetable Matter whatever, by Fire. The more volatile Alcali's, either diſcovering themſelves ſpontaneouſly,

taneouſly, as in Garlic, Onions, Scurvy-graſs, Muſtard, *&c.* or produc'd by Putrefaction from Animals or Vegetables; or procur'd by Diſtillation or Uſtion, from either of them.

3. Certain Bodies, improperly call'd Alcali's, only becauſe they agree with them in this property, that they cauſe an Effervеſcence with Acids, as Clays, almoſt all Boles, *Calculi*, Shell-fiſh, Corals, Horns, Chalk, Teeth, Stones, Crabs-eyes, Bones, Oyſter-ſhells, Earths, Clays, and Hoofs.
4. The ſeven Metals.
5. Semi-Metals, as Antimony, Biſmuth, *Lapis Calaminaris*, the *Lapis Hæmatitis*, Zincq, *&c.*

For theſe now we lay down the following Canons.

1. The Bodies of the firſt Claſs almoſt always cauſe an Effervеſcence with thoſe of the ſecond and third, ſooner or later, more or leſs, either when they are very ſtrong or diluted, and the Effervеſcence continues till the Saturation is compleat, and then ceaſes, upon which the Acrimony is almoſt conſtantly found to be ſoften'd.
2. The Bodies of the firſt Claſs excite an Effervеſcence with thoſe of the fourth, but only ſome of one with ſome of the other, and ſome in a weaker manner, others more powerfully, and when the point of Saturation is obtain'd, there is generally produc'd a Vitriol.
3. The Bodies of the firſt Claſs cauſe an Effervеſcence in the ſame manner with thoſe of the fifth.
4. The Bodies of the ſecond, third, fourth, and fifth Claſſes, upon being mix'd together, are ſcarcely obſerved to produce any Effervеſcence. Hence this power diſcovers itſelf in the Acids, in particular, when they are mix'd with the other Bodies mention'd; tho' even here too there is ſome limitation, for the ſtrongeſt Spirit of Vinegar poured upon Oil of Tartar *per Deliquium*, cauſes no Effervеſcence, tho' it does afterwards, when the Alcali is render'd weaker.

2. The moſt pure volatile Alcali, being perfectly freed from its Oil, and hence render'd exceeding ſimple, produces an Effervеſcence with the pure Acid of Vinegar, but by this means a greater degree of Cold is produc'd, whereas other Effervеſcences generate Heat in various degrees, even at laſt to burſting out into Flames. By this extraordinary Experiment, then, it appears, that an apparent motion may be increaſed with a production of Cold. See *Vol.* I. *p.* 221, *Phil. Tranſ. Abr. Vol.* III. *p.* 354, 356.

3. In other Effervеſcences there is almoſt always excited a greater degree of Heat. See *Vol.* I. *p.* 214. to 222.

4. There are ſome Fluids, which, upon being mix'd together when they are cold, in an inſtant produce true Fire. I here put 1 drachm of freſh diſtill'd Oil of Cloves into a dry hot Urinal, and placing it under the Chimney, throw upon it at once 2 drachms of *Glauber*'s Spirit of Nitre, well prepar'd, and you ſee the very moment they come into contact, there is excited a terrible Effervеſcence, upon which the whole Urinal is fill'd with a very thick black Smoke, out of the middle of which there burſts forth an exceeding red Flame. The *Impetus* being now over, there remains a light, ſpongy, brown Matter at bottom. Dr. *Slare*, *Phil. Tranſ. Abr. Vol.* III. *p.* 353, to 365. *Hoffman. Diſſert. Phyſ. Chem.* 38 to 45, 126. In ſuch caſes as theſe, now, a very powerful Acid,

that particularly of Nitre, and a very oily Oil, almoſt always meet together: Not an Alcali and an Acid. Many other Effervescences, that produce Fire, or come very near it, Monſieur *Homberg* has given us an account of. *Mem. de l'Ac. Roy. des Sc.* 1701. p. 84, 95. 1708. p. 2.

5. But betwixt ſome cold hard Bodies, there ariſes a ſpontaneous Effervescence likewiſe, and that even to ſuch a degree as produce a Flame, as we ſee in Sulphur, and Filings of Iron rubb'd together, and then work'd into a Paſte with Water.

A ſhort Recapitulation of the Doctrine of ALCALI's *and* ACIDS.

AN Alcali is a Salt, either fix'd or volatile. It is known, 1. By its Origin, which is owing either to Nature, Putrefaction, or Fire. 2. By its Matter, which is either Vegetable, Animal, or Foſſil. 3. By its Effects, as its exciting an Effervescence with Acids; its cauſing Precipitations; its combination with Oils; its Solution, in particular, of Sulphur; its changing the Colour of the *Helitropium tricoccum*, Roſes, and Violets, green, which grow red with Acids; its Taſte; and its exciting a pain like that produc'd by Fire.

An Acid is a Salt, either fix'd or volatile. It is known, 1. By its origin, which it owes either to Nature, Fermentation, or Fire. 2. By its Matter, which is either Vegetable, or Foſſil. 3. By its Effects, as its exciting an Effervescence with Alcali's, terreſtrial Subſtances, Shells of Fiſh, Corals, *&c.* its cauſing Precipitations; its combination with alcaline and terreſtrial Bodies into a neutral Matter; its Solution, in particular, of the mercurial parts of Metals; its changing the Colour of the *Helitropium tricoccum*, Roſes, and Violets, red; its Taſte; its Smell; and its exciting a gnawing, ſhooting Pain. Tho' this Doctrine however holds pretty generally true, yet it muſt not be look'd upon as infallible. Hence, if we always infer the preſence of an Acid, or Alcali, from one phyſical mark, which may be common to other Bodies, and even to theſe, when there is an Acid or Alcali preſent, we may often fall into miſtakes. Thus, if a Perſon ſhould argue in this manner, An Alcali cauſes an Effervescence with Spirit of Nitre, and Silver does ſo likewiſe, hence an Alcali and Silver are the ſame, this would not hold good; and yet ſome of the greateſt Men in the Art have been guilty of this childiſh error, calling every thing an Alcali that would cauſe an Effervescence with any Acid, than which nothing certainly can be more abſurd. Gold, again, excites an Effervescence with the acid Spirit of *Aqua Regia*, hence they ſay it is an Alcali; but it cauſes none with the acid Spirit of Nitre, and hence it is no Alcali: But the errors that ariſe from this Root are without number. How trifling therefore is the calling in the aſſiſtance of Alcali's and Acids to explain all the *Phænomena* of natural Bodies? and yet we have ſeen the time when this Doctrine was ſo much in vogue, that it was thought an honour to the Age which entertained it. Upon this head conſult Mr. *Boyle* and *Bohn*.

The Production, Deſtruction, and Alteration of SMELLS *and* TASTES.

THIS we have ſeen from the firſt of our *Proceſſes* to the laſt, there being ſcarce any one in which it has not appeared more or leſs. Conſult Mr. *Boyle* throughout his whole treatiſe, *Of the Production of ſenſible Qualities.* And read over and go through our *Proceſſes*, and you will ſee the thing abundantly.

The Production, Deſtruction, and Alteration of COLOURS.

1. ANTIMONY, when it is reduced to Powder, is naturally black; when it is calcined with *Aqua Regia*, it is yellow and greeniſh; when it is ſublimed with *Sal-Ammoniac*, it is white, red, yellow, greeniſh, and black; when the ſublimed Matter is freed from its Salt by Water, it is pretty equably red; and when Antimony is fixed with three times as much Nitre, it is white. Here then from one ſolid Body we have almoſt all kinds of Colours. And thus Mercury diſſolved in *Aqua Fortis*, and then diſtilled in a Retort, in various parts of the Retort produces various Colours from one Fluid, as we have here demonſtrated before you.

2. To produce an exceeding black Colour, by only pouring a pellucid Liquor into a clean Glaſs: Waſh a hot Glaſs with a ſolution of Vitriol of Iron perfectly ſaturated, and pour into it an infuſion of the whiteſt Galls, diluted with the pureſt Rain-water till it has ſcarcely any Colour, and then made hot. Red Roſes, Pomegranate-peels, Green-tea, Sage, and Oak-leaves, will have pretty nearly the ſame effect.

3. To change a pellucid Liquor black, by throwing into it a little quantity of a white Powder: Into a diluted pellucid infuſion of Galls made hot, throw a grain of Vitriol of Iron, well ſaturated, calcined till it is white, and heated, and it will form a black Cloud in the place where it falls, which diſperſing itſelf on every ſide through the pellucid Liquor, will render it quite black.

4. To do the ſame with a yellow Powder: Inſtead of the white Vitriol, take the ſame calcined only till it is yellow, or yellow *Ens Veneris.*

5. To do the ſame with a red Powder: Take a little Colcothar of Iron, or its Vitriol calcined till it is red, or red *Ens Veneris.*

6. To do the ſame with a drop of a pellucid Liquor: Take a little Vitriol of Iron, diſſolve it in Water, and drop it into a hot infuſion of Galls.

7. To do the ſame with a drop of a gold colour'd Liquor: Take the red *Calx* of Vitriol of Iron, draw a Tincture of a golden Colour from it with ſweet Spirit of Salt, and drop it into the ſame infuſion. In all theſe Experiments, now, as the Liquor changes from pellucid to black, there are a vaſt number of intermediate Colours produced, which all at laſt, however, end in a black one.

8. To change the black Colour produced No. 2, 3, 4, 5, 6, 7, to a pellucid one, by only pouring the Liquor into a clean Glaſs: Pour theſe black Liquors, made hot, into a Glaſs, the inſide of which has been waſhed with pure Oil of Vitriol; here the Acid abſorbs the Iron. The black Colours, however, from the *Ens Veneris*, and the red *Calx* of Iron, as they become pellucid, generate ſomewhat of a red colour.

9. To change this pellucid Colour, thus made from a black one, to a black one again: Add as much hot Oil of Tartar *per Deliquium* to the pellucid Liquor, as is ſufficient to ſaturate the Acid, which before abſorb'd the Iron. In this caſe there is excited an Effervеſcence, with a ſurprizing production, deſtruction, and regeneration of a great variety of Colours. This is beſt obſerved, when you pour in but a little of the Alcali at a time, and do it as quick as you can.

10. As ſoon as ever now you add again ſuch a quantity of Acid, that it may overcome the Alcali, the Liquor will loſe this regenerated black Colour, and

become pellucid: And thus it may be reciprocally renewed and deſtroyed. From what has been ſaid, then, we ſee how vaſtly efficacious Metals are in producing a black Colour; and with what a ſmall quantity of Matter Colours may be generated. In theſe Experiments, too, a curious Perſon may obſerve all the intermediate Colours the pellucid Liquor runs through till it comes to be exceeding black.

11. To produce a * Silver Colour, by only pouring a pellucid Liquor into a clean Glaſs: Take a ſolution of Mercury made with Spirit of Nitre to a perfect Saturation, dilute it with clean hot Water, and pour it into a hot Glaſs waſh'd with the ſtrongeſt Spirit of Salt; or pour a very dilute Solution of Silver, made with Spirit of Nitre, into the ſame; or Oil of Antimony into a Glaſs waſh'd with hot Water.

12. To produce an Orange Colour, by only pouring a pellucid Liquor into a clean Glaſs: Take a pellucid infuſion of *Crocus Metallorum* made with hot Water, and pour it into a Glaſs waſh'd with an Acid.

13. To produce a Gold Colour, by only pouring a pellucid Liquor upon a grey Powder: Pour hot Alcohol upon hot Sulphur diſſolved by a fixed Alcali, and then powdered.

14. To change a gold colour'd Liquor to a milky one, by only pouring it into a clean Glaſs: Pour the Tincture No. 13. into a Glaſs waſhed with the acid Oil of Vitriol.

15. To change a Liquor that is nearly pellucid to an azure Colour: Into Vinegar of Verdegreaſe diluted with Water till it is almoſt pellucid pour Spirit of *Sal-Ammoniac*.

16. To change an azure Colour pellucid: Add an Acid to the preceding azure Liquor till it predominates.

17. To change a very green Liquor to a beautiful Violet: Into Vinegar ſaturated with copper till it is exceeding green, pour Spirit of *Sal-Ammoniac*, till the Alcali overcomes the Acid.

18. To change an azure Colour to a beautiful green: Into a ſaturated Solution of Copper, made with Spirit of *Sal Ammoniac*, pour Vinegar, or any other Acid, till the Acid predominates.

19. Betwixt the moſt ſaturated azure Colour, and the deepeſt green, to produce a vaſt number of bluiſh and greeniſh intermediate Colours: Put a perfectly ſaturated hot Solution of Copper, made with Spirit of *Sal Ammoniac*, into a very clean cylindrical Glaſs, and drop into it ſome Spirit of Nitre, and you will obſerve an alteration in the Colour, in the manner mentioned, upon every Inſtillation.

But let this ſuffice for our preſent demonſtrations. If you have a mind to ſee this affair elegantly treated of, and illuſtrated by Experiments, conſult Mr. *Boyle*'s Treatiſe *Of Colours*. Thus then, Gentlemen, having finiſh'd our deſign, give me leave here to put an end to theſe Lectures. I return you thanks for the diligent attendance with which you have favour'd them, and the pleaſure you have ſeem'd to expreſs at 'em, and heartily wiſh they may be remember'd and improv'd in ſuch a manner as to promote the good of Mankind.

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* There is no Colour mentioned in the original, but I think it ſhould be a ſilver one.

DEO SOLI GLORIA.

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TO THE

SECOND VOLUME.

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FINIS.

ERRATA, VOL. I.

PAGE 337. *Line* 16. *read,* it adds other Particles to them. *p.* 504. *l.* 38. *r.* a pewter Veſſel, and ſo in other places where ſuch kind of Veſſels are mentioned.

ERRATA, VOL. II.

PAGE 33. *Line* 33. *Read,* the more acid. *P.* 59. *l.* 11. *r.* the leaſt quantity of. *P.* 63. *l.* 21. *r.* moſt liquid. *P.* 99. *l.* 31. *r.* ; with ſome clean Water wet. *P.* 99. *l.* 12. *r.* , yet, as far as I know, does not in Diſtillation yield ſuch inflammable *P.* 204. *l.* 22. *r.* *Epidermi*[illegible] *P.* 281. *l.* 26. *r.* the acid Spirit drawn off is 9-16ths of

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